SERVICE MANUAL

DATSUN 280Z
MODEL S30 SERIES



NISSAN

NISSAN MOTOR CO., LTD.
TOKYO, JAPAN

SECTION PD

PROPELLER SHAFT & DIFFERENTIAL CARRIER

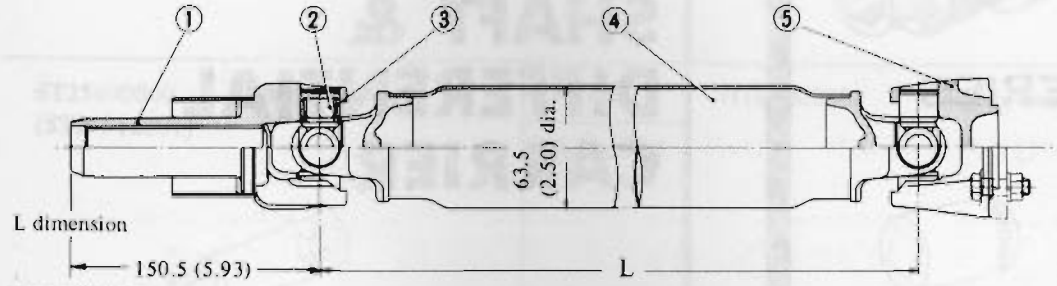
PD

PROPELLER SHAFT ..... PD- 2
DIFFERENTIAL CARRIER (Type R180) ..... PD- 4
DIFFERENTIAL CARRIER (Type R200) PD-13
SERVICE DATA AND SPECIFICATIONS PD-24
TROUBLE DIAGNOSES AND CORRECTIONS PD-26
SPECIAL SERVICE TOOLS PD-28

PROPELLER SHAFT

CONTENTS

DESCRIPTION PD-2
INSPECTION PD-2
REMOVAL PD-2
INSTALLATION PD-2
CHECKING AND CORRECTING UNBALANCED PROPELLER SHAFT PD-2
SERVICE DATA AND SPECIFICATIONS PD-3
TROUBLE DIAGNOSES AND CORRECTIONS PD-3



1 Sleeve yoke assembly
2 Journal assembly
3 Bearing race assembly
4 Propeller shaft tube assembly
5 Flange yoke

Unit: mm (in)

L: 565 (22.24): HLS30 (2 seater)
865 (34.06): GHLS30 (2 + 2 seater)

Fig. PD-1 Cross-sectional view of propeller shaft

DESCRIPTION

The propeller shaft is a 2-joint type.

The propeller shaft and universal joint assembly are carefully balanced during original assembly; that is, the dynamic unbalance is under 35 gr-cm (0.49 in-oz) at 5,800 rpm.

The length of propeller shafts differs for HLS30 (2 seater) and GHLS30 (2 + 2 seater) models.

If the propeller shaft is found damaged, replace it as an assembly. When removing or installing the propeller shaft assembly, be careful not to drop it.

INSPECTION

1. Check journal for axial play. If play exists, replace propeller shaft assembly.

Note: Journal cannot be disassembled.

2. Check the propeller shaft tube surface for dents or cracks. If necessary, replace propeller shaft assembly.

REMOVAL

1. Raise car on hoist.

Remove insulator, exhaust tube and main muffler mounting bolts to free them from car body.

2. Scribe match marks both on propeller shaft and companion flange so that shaft can be reinstalled in the original position.
3. Remove bolts securing shaft to companion flange.
4. Draw out propeller shaft sleeve yoke from transmission by moving shaft rearward, passing it under rear axle.

Watch for oil leakage from transmission rear end. Take proper action if oil leak is discovered.

Note: Remove propeller shaft carefully so as not to damage the spline, sleeve yoke or rear oil seal.

INSTALLATION

To install, reverse the foregoing removal procedure.

CAUTION:
Align propeller shaft with companion flange using reference marks prescribed in "Removal" procedure and tighten them with bolts. Failure to do so could result in driving vibration.

Tightening torque:
3.5 to 4.5 kg-m
(25 to 33 ft-lb)

CHECKING AND CORRECTING UNBALANCED PROPELLER SHAFT

To check and correct an unbalanced propeller shaft, proceed as follows:

1. Remove undercoating and other foreign material which could upset shaft balance, and check shaft vibration by road test.
2. If shaft vibration is noted during road test, disconnect propeller shaft at differential carrier companion flange, rotate companion flange 180 degrees and reinstall propeller shaft.
3. Again check shaft vibration. If vibration still persists, replace propeller shaft assembly.

SERVICE DATA AND SPECIFICATIONS

Permissible dynamic unbalance	gr-cm (in-oz)	35 (0.49) at 5,800 rpm
Axial play of spider journal	mm (in)	0 (0)
Journal swinging torque	kg-cm (in-lb)	3 to 15 (2.6 to 13.0)
Tightening torque	kg-m (ft-lb)	
Propeller shaft to companion flange bolt		3.5 to 4.5 (25 to 33)

TROUBLE DIAGNOSES AND CORRECTIONS

Condition	Probable cause	Corrective action
Vibration at medium or high speed	Worn or damaged universal joint needle bearing.	Replace propeller shaft assembly.
	Unbalance due to bent or dented propeller shaft.	Replace propeller shaft assembly.
	Loose propeller shaft installation.	Retighten.
	Worn transmission rear extension bushing.	Replace.
	Undercoating or mud on the shaft causing unbalance.	Clean shaft.
	Tire unbalance.	Balance wheel and tire assembly.
	Balance weights missing.	Replace.
Knocking sound on propeller shaft while starting or noise while coasting.	Worn or damaged universal joint.	Replace propeller shaft assembly.
	Worn sleeve yoke and main shaft spline.	Replace propeller shaft assembly.
	Loose propeller shaft installation.	Retighten.
Scraping noise	Dust cover on sleeve yoke rubbing on transmission rear extension. Dust cover on companion flange rubbing on differential carrier.	Straighten dust cover to remove interference.

DIFFERENTIAL CARRIER (Type R180)

CONTENTS

DESCRIPTION ..... PD- 4
REMOVAL ..... PD- 6
PRE-DISASSEMBLY INSPECTION ..... PD- 6
DISASSEMBLY ..... PD- 6
DISASSEMBLY OF DIFFERENTIAL CASE ..... PD- 6
INSPECTION ..... PD- 7
ASSEMBLY AND ADJUSTMENT ..... PD- 7
PRECAUTIONS IN REASSEMBLY ..... PD- 7
ASSEMBLY OF DIFFERENTIAL GEAR CASE ..... PD- 7
ADJUSTMENT OF DRIVE PINION PRELOAD ..... PD- 8
ADJUSTMENT OF DRIVE PINION HEIGHT ..... PD- 9
ADJUSTMENT OF SIDE RETAINER SHIMS PD-10
INSTALLATION PD-12
REPLACEMENT OF FRONT OIL SEAL PD-12

DESCRIPTION

The differential gear carrier assembly on the S30 series is available in the different types.

The R180 type differential carrier is adopted on automatic transmission equipped models.

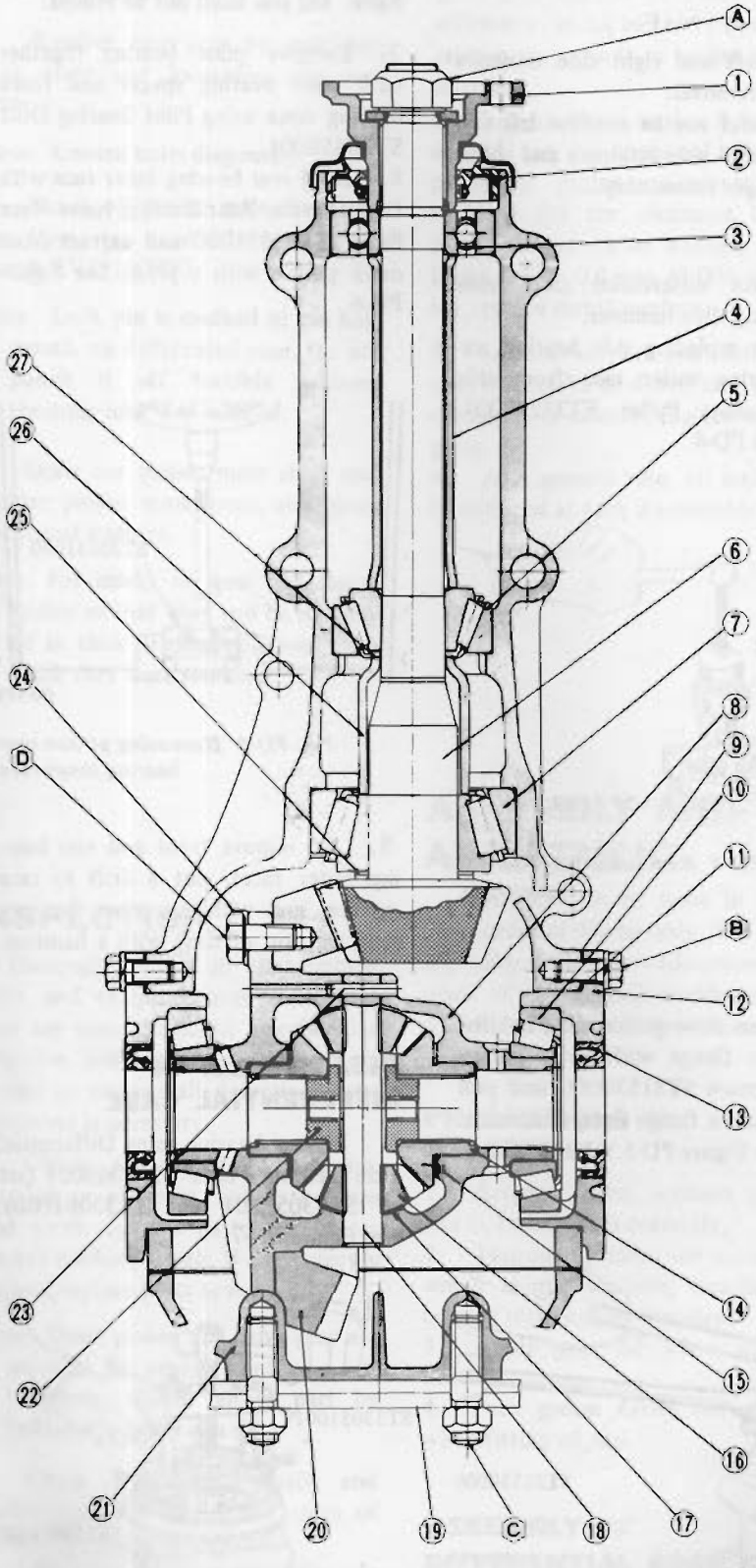
The drive pinion is mounted with one ball bearing and two tapered roller bearings which are preloaded by pinion bearing adjusting spacer and washer during assembly.

The drive pinion is positioned by a washer located between a shoulder of the drive pinion and the rear bearing.

The differential case is supported in the carrier by two tapered roller side bearings. These are preloaded by inserting shims between the carrier and the side retainers. The differential case assembly is positioned for proper ring gear-to-drive pinion backlash by varying these shims. The ring gear is bolted to the differential case. The case houses two side gears in mesh with two pinions mounted on a pinion shaft. The pinion shaft is anchored in the case by lock pin. The pinions and side gears are backed by thrust washers.

Car model	HLS30 (2 seater)		GHLS30 (2 + 2 seater)	
Transmission	Manual	Automatic	Manual	Automatic
Type of differential carrier	R200	R180	R200	R180
Gear ratio	3.545			

(TYPE R180)



1 Companion flange
2 Front oil seal (Supply grease to oil seal lip when assembling)
3 Front pilot bearing
4 Spacer-front pilot bearing
5 Pinion front bearing
6 Drive pinion
7 Pinion rear bearing
8 Differential case
9 Side retainer adjusting shim (Adjust side bearing preload and ring gear-to-drive pinion backlash by selecting ⑨.)
10 Side bearing
11 O-ring
12 Side retainer
13 Side oil seal (Supply grease to oil seal lip when assembly.)
14 Side gear
15 Thrust washer (Adjust the pinion mate-to-side gear backlash to 0.1 to 0.2 mm (0.004 to 0.008 in) by ⑮.)
16 Pinion mate
17 Thrust washer
18 Pinion mate shaft
19 Diff. mounting member
20 Ring gear
21 Rear cover
22 Side flange lock nut
23 Lock pin
24 Lock strap
25 Pinion height adjusting washer
26 Pinion bearing adjusting spacer
27 Pinion bearing adjusting washer (Adjust pinion bearing preload by selecting ㉖ and ㉗.)

Tightening torque (T) of bolts and nuts kg-m (ft-lb)
Ⓐ T : 17 to 20 (123 to 145)
Ⓑ T : 0.9 to 1.2 (6.5 to 8.7)
Ⓒ T : 6.0 to 7.0 (43 to 51)
Ⓓ T : 9.0 to 10.0 (65 to 72)

Fig. PD-2 Cross-sectional view of differential carrier

REMOVAL

Service procedures are covered under Gear Carrier in Section RA.

PRE-DISASSEMBLY INSPECTION

Differential carrier should be inspected before any parts are removed from it.

These inspections are helpful in finding the cause of the trouble and in determining the corrections needed.

1. Mount carrier on Gear Carrier Attachment KV38100800. See Figure PD-3. Remove mounting member and rear cover.

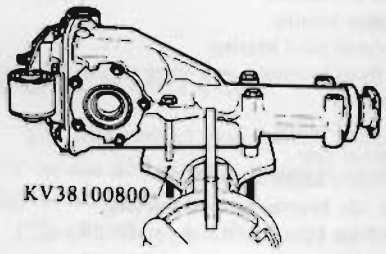


Fig. PD-3 Holding differential carrier

2. Visually inspect parts for wear or damage.
3. Rotate gears to see that there is any roughness which would indicate damaged bearings or chipped gears. Check the gear teeth for scoring or signs of abnormal wear. Measure preload of drive pinion.
4. Set up a dial indicator and check the backlash at several points around ring gear. Backlash should be within 0.10 to 0.20 mm (0.0039 to 0.0079 in).
5. Check the gear tooth contact with a mixture of recommended powder and oil apply sparingly to all ring gear teeth.

For the tooth contact pattern, see paragraph dealing with tooth contact pattern adjustment.

DISASSEMBLY

1. Remove side retainer fixing bolts, and extract side retainer.

Note:
a. Mark left and right side retainers before removal.
b. Be careful not to confuse left and right hand side retainers and shims for proper reassembly.

2. Extract differential case from carrier using slide hammer.
3. When replacing side bearing, extract bearing outer race from side retainer using Puller ST33290001. See Figure PD-4.

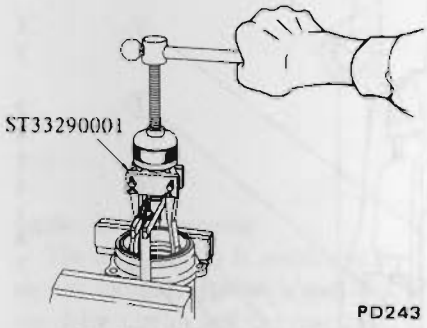


Fig. PD-4 Removing side bearing outer race

4. Loosen drive pinion nut, holding companion flange with Drive Pinion Flange Wrench ST31530000 and pull off companion flange using a standard puller. See Figure PD-5.

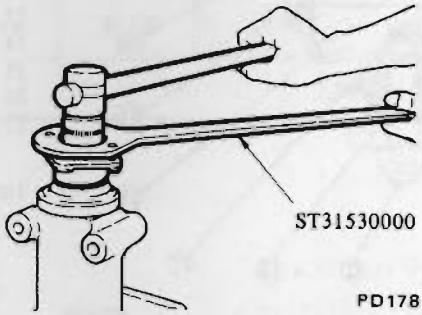


Fig. PD-5 Removing drive pinion nut

5. Extract drive pinion from carrier using a press. Take out drive pinion together with rear bearing cone, bearing spacer and adjusting washers.
6. Remove front oil seal.

Note: Oil seal must not be reused.

7. Remove pilot bearing together with pilot bearing spacer and front bearing cone using Pilot Bearing Drift ST30650001.
8. Hold rear bearing inner race with Drive Pinion Rear Bearing Inner Race Puller ST30031000 and extract from drive pinion with a press. See Figure PD-6.

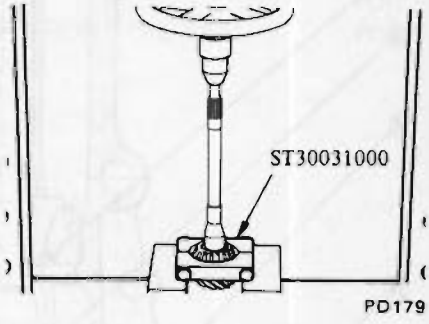


Fig. PD-6 Removing pinion rear bearing inner race

9. To remove front and rear bearing outer races, put a drift to race surface, and withdraw them by tapping the top of drift with a hammer.

DISASSEMBLY OF DIFFERENTIAL CASE

1. Extract bearing using Differential Side Bearing Puller ST3306S001 (set of ST33051001 and ST33061000). See Figure PD-7.

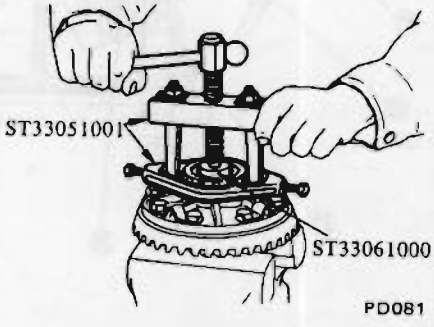


Fig. PD-7 Removing side bearing

Note:
a. The puller should be handled with care in catching the edge of bearing inner race.
b. Be careful not to confuse the left and right hand parts.

2. Remove ring gear by unfolding lock strap and loosening ring gear bolts.

Note: Loosen bolts diagonally.

3. Punch off pinion mate shaft lock pin from ring gear side using Solid Punch KV31100300.

Note: Lock pin is caulked at pin hole mouth on differential case. Do not punch it off forcibly without checking how it is caulked.

4. Draw out pinion mate shaft and remove pinion mate gears, side gears and thrust washers.

Note: Put marks on gear and thrust washer so that they can be reinstalled in their original positions from which they were removed.

INSPECTION

Thoroughly clean all disassembled parts, and examine them to see that they are worn, damaged or otherwise defective, and how they are affected. Repair or replace all defective parts, whichever is necessary.

1. Check gear teeth for scoring, cracking or chipping, and make sure that tooth contact pattern indicates correct meshing depth. If any defect is evident, replace parts as required.

Note: Drive pinion and drive gear are supplied for replacement as a set, therefore, should either part be damaged, replace as a set.

2. Check pinion gear shaft, and pinion gear for scores and signs of wear, and replace as required.

Follow the same procedure for side gear and their seats on differential case.

3. Inspect all bearing races and rollers for scoring, chipping or evidence of excessive wear. They should be in tiptop condition such as not worn and with mirror-like surfaces. Replace if there is a shadow of doubt on their efficiency, as an incorrect bearing operation may result in noises and gear seizure.
4. Inspect thrust washer faces. Small defects can be corrected with sand paper. If pinion mate-to-side gear backlash (or the clearance between side gear and thrust washer) exceeds limits 0.1 to 0.2 mm (0.004 to 0.008 in), replace thrust washers.
5. Inspect carrier and differential case for cracks or distortion. If either condition is evident, replace defective parts.
6. As a general rule, oil seal should be replaced at each disassembly.

ASSEMBLY AND ADJUSTMENT

Assembly can be done in the reverse order of disassembly. The following directions for adjustment and usage of special tools enable to obtain a perfect differential operation.

PRECAUTIONS IN REASSEMBLY

1. Arrange shims, washers and the like to install them correctly.
2. Thoroughly clean the surfaces on which shims, washers, bearings and bearing retainers are installed.
3. Apply gear oil when installing bearings.
4. Pack grease cavity between lips when fitting oil seal.

ASSEMBLY OF DIFFERENTIAL GEAR CASE

1. Assemble pinion mates, side gears and thrust washers in differential case.
2. Fit pinion shaft to differential case so that it meets lock pin holes.
3. Adjust side gear-to-pinion mate backlash or adjust the clearance between the rear face of side gear and thrust washer. See Figure PD-8.

If above procedure is not effective with existing washer, try with other washers available for the purpose.

Normal backlash or clearance:
0.1 to 0.2 mm
(0.004 to 0.008 in)

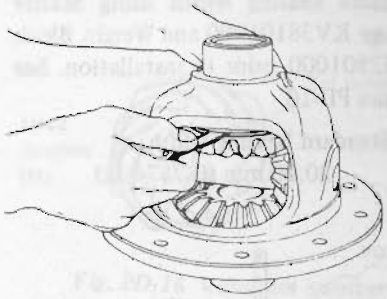


Fig. PD-8 Measuring clearance

Side gear thrust washer

Thickness mm (in)
0.75 to 0.80 (0.0295 to 0.0315)
0.80 to 0.85 (0.0315 to 0.0335)
0.85 to 0.90 (0.0335 to 0.0354)

4. Lock pinion shaft lock pin using a punch after it is secured into place.
5. Apply oil to gear tooth surfaces and thrust surfaces and check if they turn properly.
6. Place ring gear on differential case and install bolts and lock washers.

Tightening torque:
9.0 to 10.0 kg-m
(65 to 72 ft-lb)

CAUTION:
a. Use only genuine ring gear bolts and new lock straps.
b. Tighten bolts in criss-cross fashion lightly tapping around bolt heads with a hammer. See Figure PD-9.

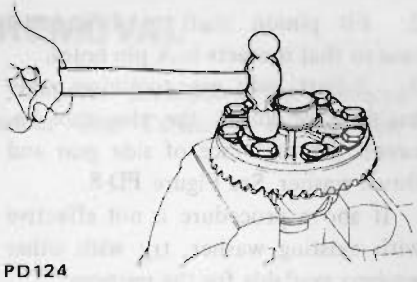


Fig. PD-9 Tapping bolt head

7. When replacing side bearing, measure bearing width using Master Gauge KV38101900 and Weight Block ST32501000 prior to installation. See Figure PD-10.

Standard bearing width:
20.00 mm (0.7874 in)

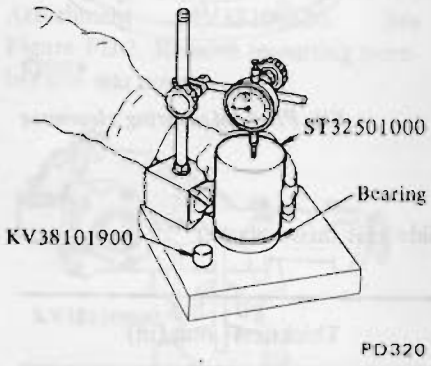


Fig. PD-10 Measuring bearing width

8. Press fit side bearing cone on differential case using Gear Carrier Side Bearing Drift ST33230000 and Adapter ST33061000. See Figure PD-11.

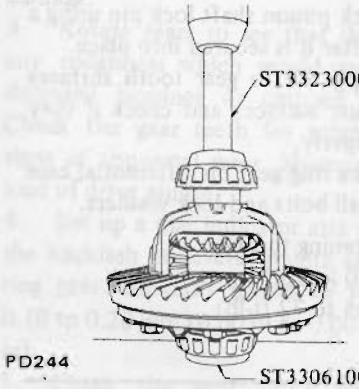


Fig. PD-11 Installing side bearing cone

9. Press fit side bearing outer race into side retainer using Drive Pinion Outer Race Drift Set ST30611000 and ST30621000.

10. Set new oil seal on side retainer using Oil Seal Drift Assembly ST33270000. Apply grease cavity between seal lips.

ADJUSTMENT OF DRIVE PINION PRELOAD

Adjust preload of drive pinion with spacer and washer between front and rear bearing cones, regardless of thickness of pinion height adjusting washer.

This adjustment must be carried out without oil seal inserted.

1. Press fit front and rear bearing outer races into gear carrier using Drive Pinion Outer Race Drift Set ST30611000, ST30701000 and ST30621000.

Front:	ST30611000 and ST30701000
Rear:	ST30611000 and ST30621000

2. Insert Dummy Shaft Spacer ST31851000, pinion height adjusting washer (use one of 3.09 to 3.27 thickness) and rear bearing cone into Dummy Shaft ST31212000 to make convenient to adjust pinion height. See Figure PD-14.

Note: Reuse the old washer if they have normal tooth contact pattern in a pre-disassembly check.

3. Fit drive pinion bearing spacer, washer, front bearing cone, Drive Pinion Dummy Collar ST31214000 and companion flange in this order on dummy shaft and tighten drive pinion nut to the specified torque using Stopper ST31852000 and checking pinion bearing preload. See Figure PD-12.

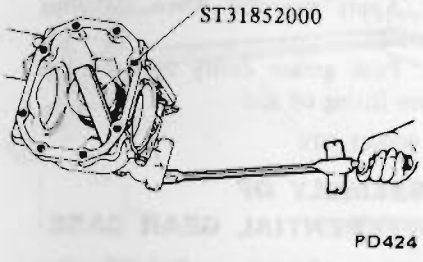


Fig. PD-12 Tightening drive pinion nut

Measure pinion bearing preload using Preload Gauge ST3127S000, and select washer and spacer that will provide required preload. See Figure PD-13.

Pinion bearing preload
(Without oil seal):
10 to 13 kg-cm
(8.7 to 11.3 in-lb)
Tightening torque of
pinion nut:
17 to 20 kg-m
(123 to 145 ft-lb)

Note: Replace bearing washer and spacer with thicker ones if pinion cannot be turned by hand while it is being tightened.

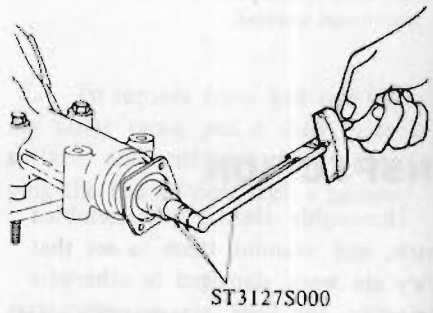


Fig. PD-13 Measuring pinion preload

Pinion bearing adjusting spacer

Length mm (in)
52.20 (2.0551)
52.40 (2.0630)
52.60 (2.0709)
52.80 (2.0787)
53.00 (2.0866)
53.20 (2.0945)

Pinion bearing adjusting washer

Thickness mm (in)
2.30 to 2.32 (0.0906 to 0.0913)
2.32 to 2.34 (0.0913 to 0.0921)
2.34 to 2.36 (0.0921 to 0.0929)
2.36 to 2.38 (0.0929 to 0.0937)
2.38 to 2.40 (0.0937 to 0.0945)
2.40 to 2.42 (0.0945 to 0.0953)
2.42 to 2.44 (0.0953 to 0.0961)
2.44 to 2.46 (0.0961 to 0.0969)
2.46 to 2.48 (0.0969 to 0.0976)
2.48 to 2.50 (0.0976 to 0.0984)
2.50 to 2.52 (0.0984 to 0.0992)
2.52 to 2.54 (0.0992 to 0.1000)
2.54 to 2.56 (0.1000 to 0.1008)
2.56 to 2.58 (0.1008 to 0.1016)
2.58 to 2.60 (0.1016 to 0.1024)

ADJUSTMENT OF DRIVE PINION HEIGHT

Adjust pinion height with washer provided between rear bearing cone and back of pinion gear.

1. Install Height Gauge ST31211000 on carrier with dummy shaft mounted. See Figure PD-14.
2. Measure the clearance (N) between the tip end of height gauge and the end surface of dummy shaft, using a thickness gauge. See Figure PD-15.

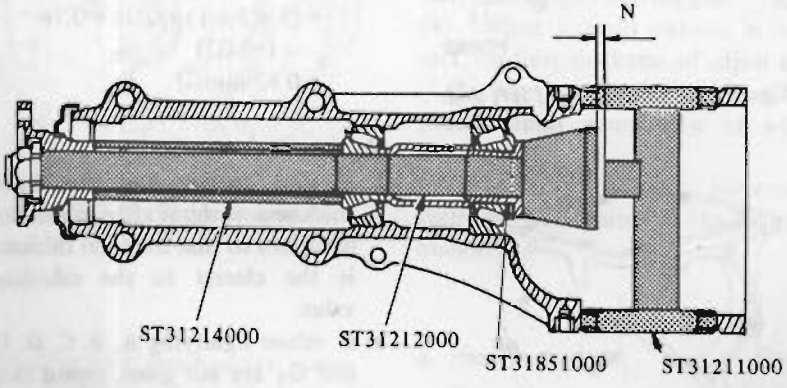


Fig. PD-14 Measuring the clearance

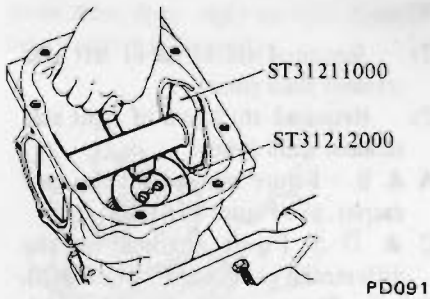


Fig. PD-15 Adjusting pinion height

3. The thickness of drive pinion height adjusting washer can be obtained from the following formula:

$$T = W + N - [(H - D' - S) \times 0.01] - 0.2$$

Where,

- T : Required thickness of rear bearing adjusting washers (mm).
- W : Thickness of washers temporarily inserted (mm).
- N : Measured value with thickness gauge (mm).
- H : Figure marked on the drive pinion head. See Figure PD-16.
- D' : Figure marked on the dummy shaft.
- S : Figure marked on the height gauge.

Figures for H, D' and S are dimensional variations in a unit of 1/100 mm against each standard measurement.

Example of calculation

W = 3.09 mm
N = 0.33 mm
H = +2, D' = −1, S = 0

$$T = W + N - [(H - D' - S) \times 0.01] - 0.2$$
$$= 3.09 + 0.33 - [(2 - (-1) - 0) \times 0.01] - 0.2$$
$$= 3.19 \text{ mm}$$

The correct washer is 3.18 mm thick.

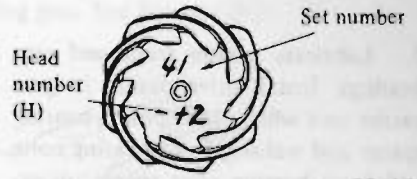
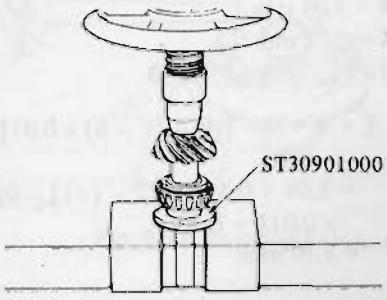


Fig. PD-16 Variation number on drive pinion

Pinion height adjusting washer

Thickness mm (in)
3.09 (0.1217)
3.12 (0.1228)
3.15 (0.1240)
3.18 (0.1252)
3.21 (0.1264)
3.24 (0.1276)
3.27 (0.1287)
3.30 (0.1299)
3.33 (0.1311)
3.36 (0.1323)
3.39 (0.1335)
3.42 (0.1346)
3.45 (0.1358)
3.48 (0.1370)
3.51 (0.1382)
3.54 (0.1394)
3.57 (0.1406)
3.60 (0.1417)
3.63 (0.1429)
3.66 (0.1441)

4. Fit determined pinion height adjusting washer in drive pinion, and press fit rear bearing cone in it using Base ST30901000. See Figure PD-17.



PD417

Fig. PD-17 Pressing rear bearing cone

5. Lubricate pinion front and rear bearings. Install drive pinion in gear carrier into which drive pinion bearing spacer and wahser, front bearing cone and front bearing pilot spacer, moreover, pilot bearing and oil seal are fitted. Fit oil seal using Oil Seal Drift ST30720000.
6. Press fit companion flange in drive pinion and secure them in position by tightening nut to specified torque confirming preload.

Tightening torque:
17 to 20 kg-m
(123 to 145 ft-lb)
Preload (with oil seal):
11 to 17 kg-cm
(9.5 to 14.8 in-lb)

Note: If drive pinion lock nut is worn, replace it.

ADJUSTMENT OF SIDE RETAINER SHIMS

1. If the hypoid gear set, carrier, differential case, side bearing or side bearing retainer has been replaced with new part, adjust the side bearing preload with adjusting shim. The required thicknesses of the left and right retainer shims can be obtained from the following formulas:

$T_1 = (A + C + G_1 - D) \times 0.01 + 0.76 - E$

$T_2 = (B + D + G_2) \times 0.01 + 0.76 - F$

Where,

T_1 : Required thickness of left side retainer shim (mm).

T_2 : Required thickness of right side retainer shim (mm).

A & B : Figure marked on the gear carrier. See Figure PD-19.

C & D : Figure marked on the differential case. See Figure PD-20.

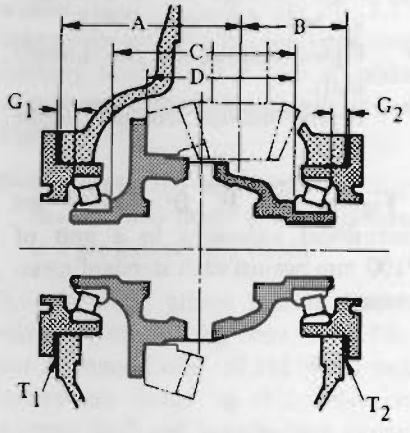
E & F : These are differences in width of left or right side bearing against the standard width 20.0 mm (0.787 in).

G_1 & G_2 : Figure marked on the left or right side retainer. See Figure PD-21.

Note: Figures for A, B, C, D, G_1 and G_2 are dimensional variations in a unit of 1/100 mm (4/10,000 in) against each standard measurement.

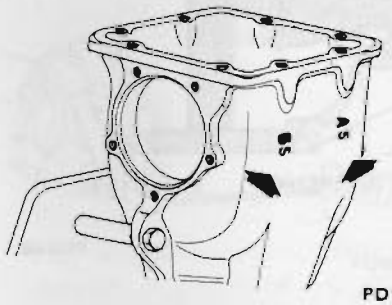
To measure width of side bearing, see differential case assembly procedure.

Note: Preload of the old bearing should be the same as that of a new bearing.



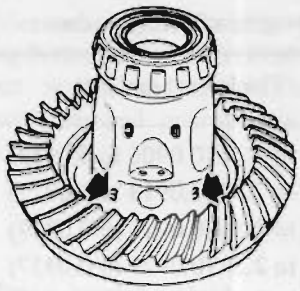
PD093

Fig. PD-18 Thickness of left and right shims



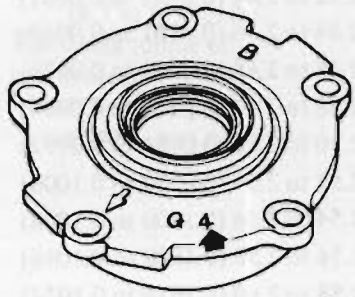
PD187

Fig. PD-19 A & B figure



PD188

Fig. PD-20 C & D figures



PD189

Fig. PD-21 G1 & G2 figure

Example of calculation,

A = 5, B = 5, C = 3, D = 3,
G_1 = 4, G_2 = 1, E = −0.01 mm,
F = +0.02 mm

Left side:

$T_1 = (A + C + G_1 - D) \times 0.01 + 0.76 - E$
$= [5 + 3 + 4 - (+3)] \times 0.01 + 0.76 - (-0.01)$
$= 0.86$ mm

Right side:

$T_2 = (B + D + G_2) \times 0.01 + 0.76 - F$
$= (5 + 3 + 1) \times 0.01 + 0.76 - (+0.02)$
$= 0.83$ mm

Note:

a. If you cannot find the desired thickness of shims after calculation, use shims so that the total thickness is the closest to the calculated value.

b. If values signifying A, B, C, D, G_1 and G_2 are not given, regard them as zero and compute.
After assembly, check to see that preload and backlash are correct. If not, readjust.

Side retainer adjusting shim

Thickness mm (in)
0.20 (0.0079)
0.25 (0.0098)
0.30 (0.0118)
0.40 (0.0157)
0.50 (0.0197)

2. Install differential case assembly in gear carrier in reverse order to which it is disassembled.
3. Fit given shims and O-ring in both side retainers, and install retainers in carrier using Gear Carrier Side Retainer Guide ST33720000 (See Figure PD-22), and the arrow mark on retainer positioned as shown in Figure PD-23.

Note: When installing retainers, take care that side bearing outer races are not damaged by roller.

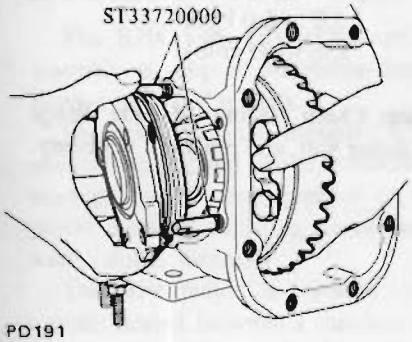


Fig. PD-22 Installing side retainer

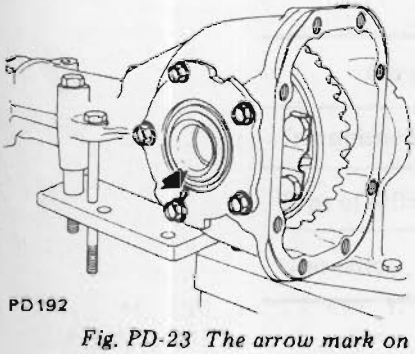


Fig. PD-23 The arrow mark on retainer

4. Measure ring gear-to-drive pinion backlash by using a dial indicator and adjust it to 0.10 to 0.20 mm (0.0039 to 0.0079 in). See Figure PD-24.

If it is below the specified value, move shim from right to left. If it is over it, move it inversely.

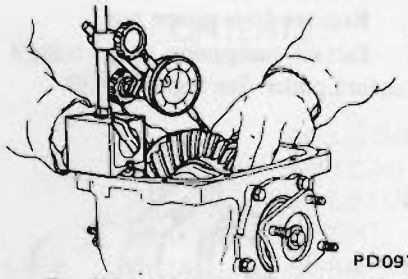


Fig. PD-24 Measuring the backlash of ring gear and pinion

5. At the same time, check side bearing preload. Bearing preload should be 12 to 20 kg-cm (10 to 17 in-lb) of rotating torque at companion flange.

If preload is not according to this specification, adjust it with side retainer shims.

Incidentally, decrease or increase in thickness of shims causes change of ring gear-to-pinion backlash.

Thus, check if they have proper backlash.

6. Check and adjust the tooth contact pattern of ring gear and drive pinion.

(1) Thoroughly clean ring and drive pinion gear teeth.

(2) Paint ring gear teeth lightly and evenly with a mixture of recommended powder and oil of a suitable consistency to produce a contact pattern.

(3) Rotate pinion through several revolutions in the forward and reverse direction until a definite contact pattern is developed on ring gear.

(4) When contact pattern is incorrect, readjust thickness of adjust shim.

Be sure to wipe off red lead completely upon completion of adjustment.

(5) Incorrect contact pattern of teeth can be adjsuted in the following manner.

a. Heel contact

To correct, increase thickness of drive pinion adjusting washer in order to bring drive pinion close to ring gear. See Figure PD-25.

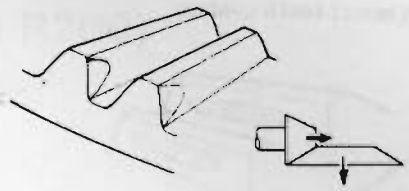


Fig. PD-25 Heel contact

b. Toe contact

To correct, reduce thickness of drive pinion adjusting washer in order to make drive pinion go away from ring gear. See Figure PD-26.

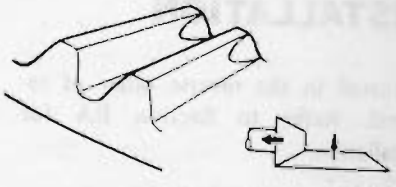


Fig. PD-26 Toe-contact

c. Flank contact

Adjust in the same manner as in b. See Figure PD-27.

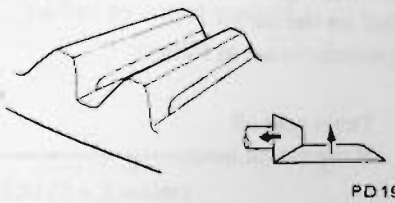


Fig. PD-27 Flank contact

d. Face contact

Adjust in the same manner as in a. See Figure PD-28.

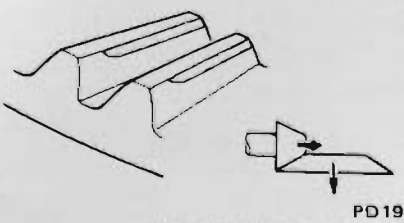
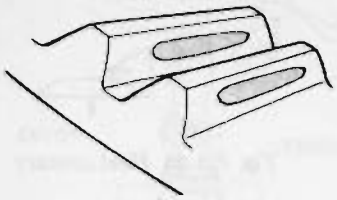


Fig. PD-28 Face contact

e. Correct tooth contact



PD197

Fig. PD-29 Correct contact

Note: Change in thickness of adjusting washer is accompanied by change in backlash. Check it when installing gear.

INSTALLATION

Install in the reverse order of removal. Refer to Section RA for Installation.

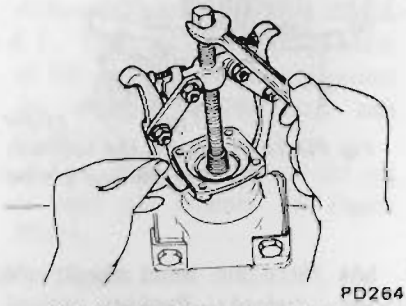
Note: Oil quantity: 1 liter
(2 1/8 U.S. pt., 1 3/4 Imp. pt.)

REPLACEMENT OF FRONT OIL SEAL

Replacement of front oil seal with differential gear carrier assembly installed on the car.

procedures are as follows:

1. Drain gear oil.
2. Raise car on hoist.
3. Remove insulator, exhaust tube and main muffler mounting bolts to free them from car body.
4. Detach propeller shaft.
5. Remove drive pinion nut.
6. Extract companion flange using a standard puller. See Figure PD-30.



PD264

Fig. PD-30 Removing companion flange

7. Remove oil seal.
8. Set new oil seal in position using Gear Carrier Oil Seal Drift ST30720000. Apply grease cavity between seal lips.
9. Fit companion flange on drive pinion, and secure them in position by tightening nut to specified torque confirming the following preload, using Drive Pinion Flange Wrench ST31530000.

Tightening torque of
pinion nut:
17 to 20 kg-m
(123 to 145 ft-lb)
Pinion bearing preload
(with oil seal):
11 to 17 kg-cm
(9.5 to 14.8 in-lb)

Note: The preload of old bearing is the same value as that of a new bearing.

10. Reinstall propeller shaft by reversing the foregoing removal procedure. And fill up gear oil.

Side oil seal is replaced by using the following procedures.

(1) Detach drive shaft from gear carrier.
(2) Remove oil seal.
(3) Set in new oil seal.

Note: Apply grease cavity between oil seal lips.

(4) Reinstall drive shaft.

Tightening torque of
flange yoke fixing bolt:
3.2 to 4.3 kg-m
(23 to 31 ft-lb)
Drive shaft to companion
flange fixing bolt:
5.0 to 6.0 kg-m
(36 to 43 ft-lb)

Note: Check O-ring of side flange fixing bolt, and replace if necessary.

DIFFERENTIAL CARRIER (Type R200)

CONTENTS

DESCRIPTION PD-13
REMOVAL PD-15
PRE-DISASSEMBLY INSPECTION PD-15
DISASSEMBLY PD-15
DISASSEMBLY OF DIFFERENTIAL CASE .. PD-16
INSPECTION PD-17
ASSEMBLY AND ADJUSTMENT PD-17
PRECAUTIONS IN REASSEMBLY PD-17
ASSEMBLY OF DIFFERENTIAL GEAR CASE PD-17
ADJUSTMENT OF DRIVE PINION PRELOAD PD-18
ADJUSTMENT OF DRIVE PINION HEIGHT PD-18
ADJUSTMENT OF SIDE BEARING WASHERS PD-20
INSTALLATION PD-22
REPLACEMENT OF OIL SEALS PD-22
FRONT OIL SEAL PD-22
SIDE OIL SEAL PD-23

DESCRIPTION

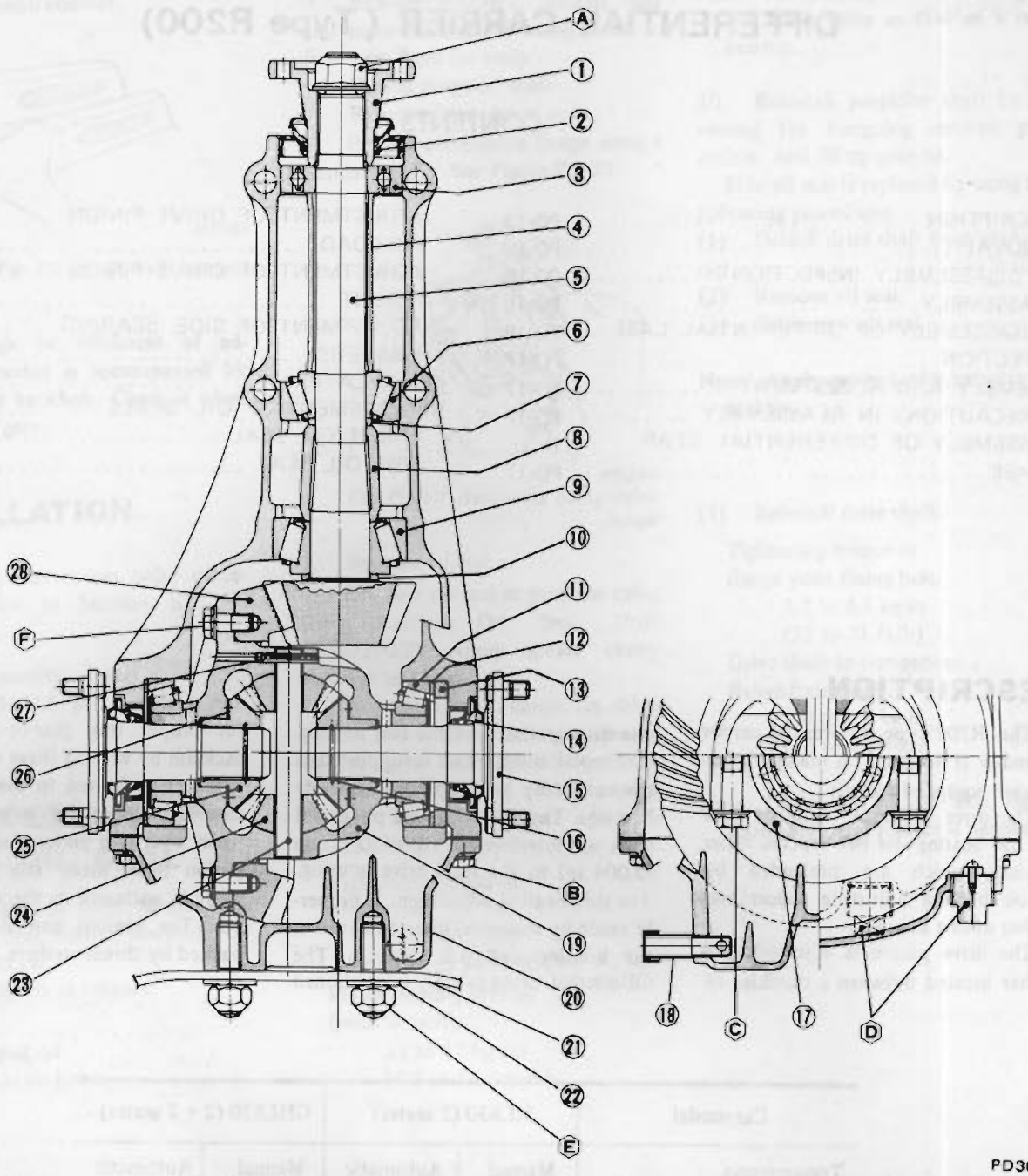
The R200 type differential carrier assembly is adopted on manual transmission equipped models.

The drive pinion is mounted with one ball bearing and two tapered roller bearings which are preloaded by pinion bearing adjusting spacer and washer during assembly.

The drive pinion is adjusted by a washer located between a shoulder of the drive pinion and the rear bearing.

The differential case is supported in the carrier by two tapered roller side bearings. These bearings are preloaded with an interference fit of 0.1 mm (0.004 in) to the final drive housing. The side bearing adjustment is properly made by washer(s) inserted between the housing and side bearings. The differential case assembly is positioned for proper ring gear-to-drive pinion backlash by varying these washers. The ring gear is bolted to the differential case. The case houses two side gears in mesh with two pinions mounted on a pinion mate shaft. The pinion mate shaft is anchored in the case by lock pin. The pinions and side gears are backed by thrust washers.

Car model	HLS30 (2 seater)		GHLS30 (2 + 2 seater)	
Transmission	Manual	Automatic	Manual	Automatic
Type of differential carrier	R200	R180	R200	R180
Gear ratio	3.545			



PD369

1 Companion flange
2 Front oil seal
(Supply multi-purpose grease to oil seal lip when assembling)
3 Front pilot bearing
4 Front pilot bearing spacer
5 Drive pinion
6 Pinion front bearing
7 Pinion bearing adjusting washer
(Adjust pinion bearing preload by selecting ⑦ and ⑧.)
8 Pinion bearing adjusting spacer
9 Pinion rear bearing
10 Pinion height adjusting washer
(Adjust pinion height by selecting ⑩.)
11 Side bearing
12 Side bearing adjusting washer
(Adjust side bearing preload and ring gear-to-drive pinion backlash by selecting ⑫.)
13 Side bearing spacer
14 Side oil seal
(Supply multi-purpose grease to oil seal lip when assembling)
15 Side flange
16 Side flange circlip
17 Side bearing cap
18 Breather
(Install with an arrow towards front.)
19 Differential case
20 Rear cover
21 Differential rear mounting member
22 Special washer
23 Pinion mate shaft
24 Pinion mate
25 Side gear
26 Thrust washer
(Adjust the pinion mate-to-side gear backlash (or the clearance between the rear face of side gear and thrust washer) to 0.1 to 0.2 mm (0.004 to 0.008 in) by ㉖.)
27 Lock pin
28 Ring gear

Tightening torque (T) of bolts and nuts kg-m (ft-lb)
Ⓐ T : 19 to 22 (137 to 159)
Ⓑ T : 1.6 to 2.4 (12 to 17)
Ⓒ T : 9.0 to 10.0 (65 to 72)
Ⓓ T : 4.2 to 6.9 (30 to 50)
Ⓔ T : 7.5 to 9.5 (54 to 69)
Ⓕ T : 6.0 to 7.0 (43 to 51)

Using locking agent [Locktite (stud lock) or equivalent]

Fig. PD-31 Sectional view of differential carrier

REMOVAL

Service procedures are covered under Gear Carrier in Section RA.

PRE-DISASSEMBLY INSPECTION

Differential carrier should be inspected before parts except rear cover are removed from it.

These inspections are helpful in finding the cause of the problem and in determining necessary corrections.

1. Using three 45 mm (1.77 in) spacers, mount carrier on Gear Carrier Attachment KV38100800.

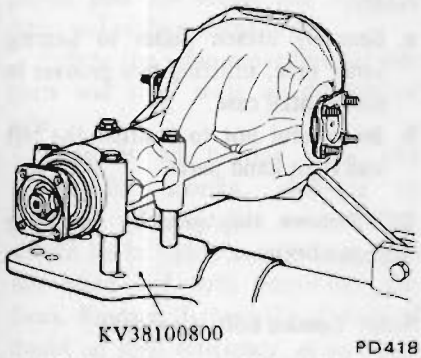


Fig. PD-32 Mounting differential carrier

2. Remove rear cover.
3. Visually inspect parts for wear or damage.
4. Rotate gears checking for any roughness which would indicate damaged bearings or chipped gears. Check gear teeth for scoring or signs of abnormal wear. Measure preload of drive pinion.

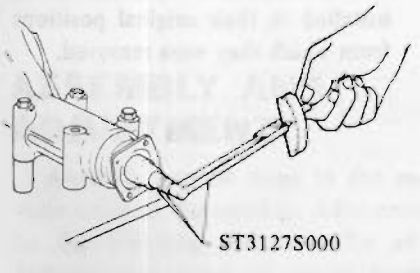


Fig. PD-33 Measuring pinion preload

5. Set up a dial indicator and check the backlash at several points around ring gear. Backlash should be within 0.13 to 0.18 mm (0.0051 to 0.0071 in).

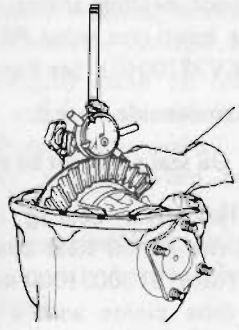


Fig. PD-34 Measuring the backlash of ring gear and pinion

6. Check gear tooth contact with a mixture of recommended powder and oil.

For the tooth contact pattern, see page PD-22 – Contact Pattern.

DISASSEMBLY

1. Drive side flange out with pry bar. See Figure PD-35.

Note: Hold side flange with hand to prevent it from jumping out of carrier.

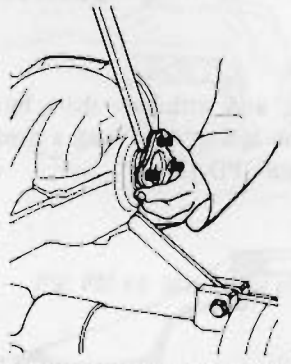


Fig. PD-35 Removing side flange

2. Put match marks on side bearing caps and carrier.
3. Loosen side bearing cap bolts and remove bearing caps.

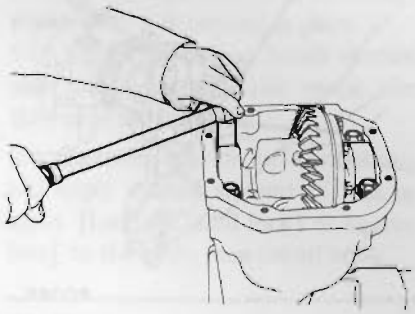


Fig. PD-36 Removing side bearing cap

4. Using Slide Hammer HT72400000 lift differential case assembly out. See Figure PD-37.

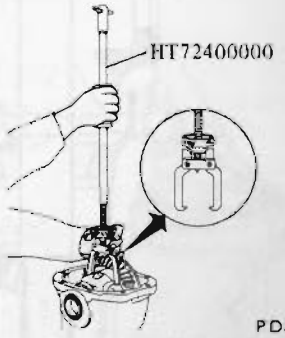


Fig. PD-37 Removing differential case assembly

Note: Care should be taken not to confuse the left and right hand bearing caps and bearing outer races so that parts may be installed to the original position.

5. Loosen drive pinion nut, holding companion flange with Drive Pinion Flange Wrench ST31530000 and pull off companion flange using a suitable puller. See Figures PD-38 and PD-39.

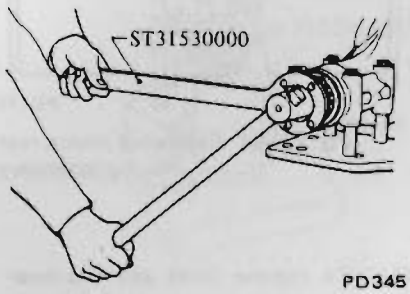
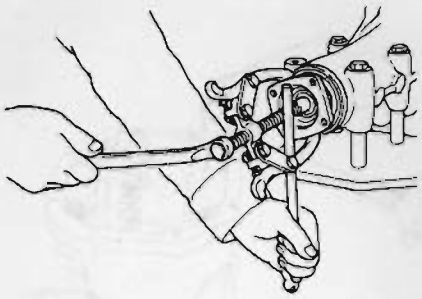


Fig. PD-38 Removing drive pinion nut



PD346

Fig. PD-39 Removing companion flange

6. Extract drive pinion from carrier using a press. Take out drive pinion together with rear bearing inner race, bearing spacer and adjusting washer.

7. Remove oil seal.

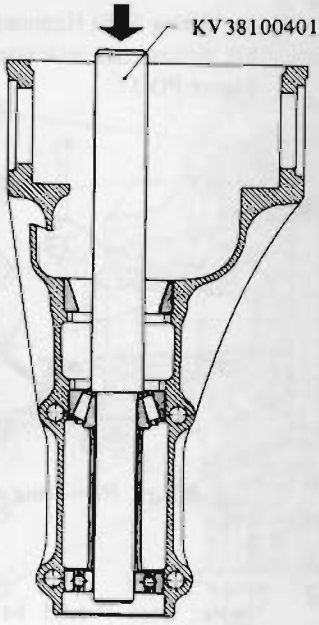
Note: Oil seal must not be reused.

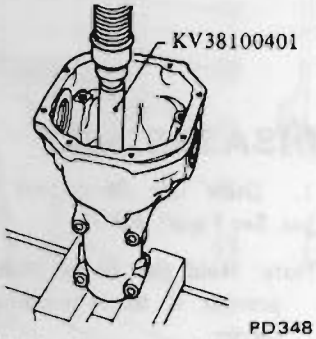
8. Remove pilot bearing together with pilot bearing spacer and front bearing inner race using Pilot Bearing Drift KV38100401. See Figure PD-40.

9. Remove side oil seal.

Note: Oil seal must not be reused.

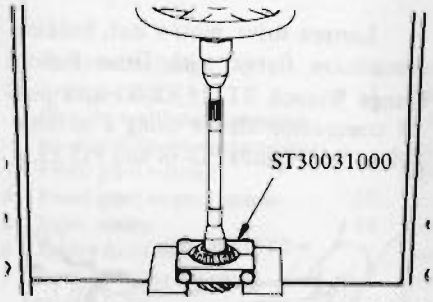
10. Hold rear bearing inner race with Drive Pinion Rear Bearing Inner Race Puller ST30031000 and extract from drive pinion with a press. See Figure PD-41.





PD348

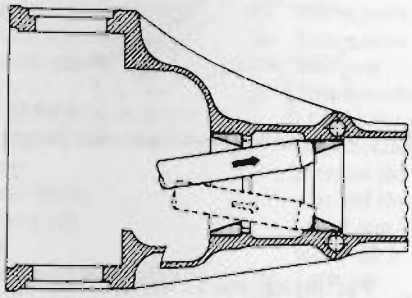
Fig. PD-40 Removing pilot bearing



PD179

Fig. PD-41 Removing pinion rear bearing inner race

11. To remove front and rear bearing outer races, put a drift to race surface, and withdraw them by tapping the top of drift with a hammer. See Figure PD-42.

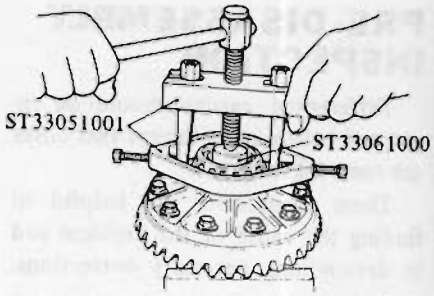


PD349

Fig. PD-42 Removing pinion bearing outer races

DISASSEMBLY OF DIFFERENTIAL CASE

1. Extract bearing using Differential Side Bearing Puller ST3306S001 (set of ST33051001 and ST33061000). See Figure PD-43.



PD350

Fig. PD-43 Removing side bearing

Note:

a. Securely attach puller to bearing inner race, utilizing two grooves in differential case.
b. Be careful not to confuse the left and right hand parts.

2. Remove ring gear by loosening ring gear bolts.

Note: Loosen bolts diagonally.

Punch off pinion mate shaft lock pin from ring gear side using Sold Punch KV31100300.

Note: Lock pin is caulked at pin hole mouth on differential case. Do not punch it off forcibly without checking how it is caulked.

4. Draw out pinion mate shaft and remove pinion mate gears, side gears and thrust washers.

Note: Put marks on gear and thrust washer so that they can be re-installed in their original positions from which they were removed.

INSPECTION

Thoroughly clean all disassembled parts, and examine them to see that they are worn, damaged or otherwise faulty, and how they are affected. Repair or replace all faulty parts, whichever is necessary.

1. Check gear teeth for scoring, cracking or chipping, and make sure that tooth contact pattern indicates correct meshing depth. If any fault is evident, replace parts as required.

Note: **Drive pinion and drive gear are supplied for replacement as a set, therefore, should either part be damaged, replace as a set.**

2. Check pinion gear shaft, and pinion gear for scores and signs of wear, and replace as required.

Follow the same procedure for side gears and their seats on differential case.

3. Inspect all bearing races and rollers for scoring, chipping or evidence of excessive wear. They should be in tiptop condition such as not worn and with mirror-like surfaces. Replace if there is a shadow of doubt on their efficiency, as an incorrect bearing operation may result in noise and gear seizure.

4. Inspect thrust washer faces. Small faults can be corrected with sandpaper. If pinion mate to side gear backlash (or the clearance between side gear and thrust washer) exceeds limits 0.1 to 0.2 mm (0.004 to 0.008 in), replace thrust washers.

5. Inspect carrier and differential case for cracks or distortion. If either condition is evident, replace faulty parts.

6. As a general rule, oil seal should be replaced at each disassembly.

ASSEMBLY AND ADJUSTMENT

Assembly can be done in the reverse order of disassembly. Adherence to the following directions for adjustment and usage of special tools enable to obtain a perfect differential operation.

PRECAUTIONS IN REASSEMBLY

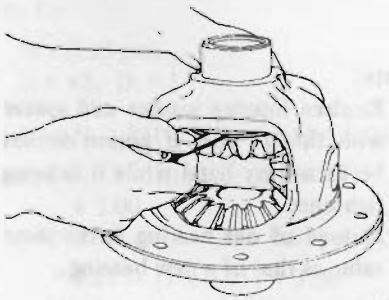
1. Arrange shims, washers and the like to install them correctly.
2. Thoroughly clean the surfaces on which shims, washers, bearings and bearing retainers are installed.
3. Thoroughly clean oil from ring gear bolt and its hole with "Locktite Lacquic Primer" or equivalent.
4. Apply gear oil when installing bearings.
5. Pack recommended multi-purpose grease into cavity between lips when fitting oil seal.

ASSEMBLY OF DIFFERENTIAL GEAR CASE

1. Assemble pinion mates, side gears and thrust washers in differential case.
2. Fit pinion shaft to differential case so that it meets lock pin holes.
3. Adjust side gear-to-pinion mate backlash or adjust the clearance between the rear face of side gear and thrust washer. See Figure PD-44.

If above procedure is not effective with existing washer, try with other washers.

Normal backlash or clearance:
0.1 to 0.2 mm
(0.004 to 0.008 in)



PD023

Fig. PD-44 Measuring clearance

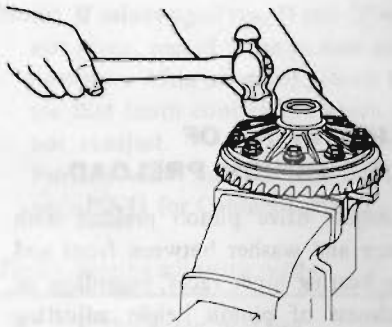
Side gear thrust washer

Thickness mm (in)
0.75 to 0.80 (0.0295 to 0.0315)
0.80 to 0.85 (0.0315 to 0.0335)
0.85 to 0.90 (0.0335 to 0.0354)

4. Lock pinion shaft lock pin using a punch after it is secured in place.
5. Apply oil to gear tooth surfaces and thrust surfaces and check that they turn properly.
6. Place ring gear on differential case and apply a small amount of locking agent [Locktite (stud lock) or equivalent] to the bolts; then install bolts.

CAUTION:
a. Use only genuine drive gear bolts and new lock straps.
b. Tighten bolts in criss-cross fashion lightly tapping around bolt heads with a hammer.

Tightening torque:
7 to 8 kg-m
(51 to 58 ft-lb)

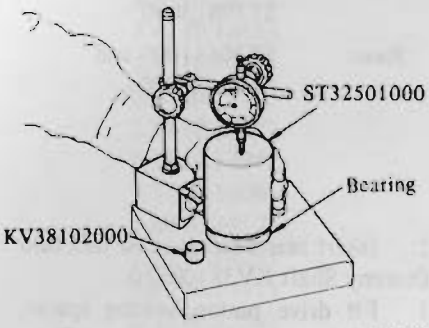


PD351

Fig. PD-45 Tapping bolt heads

7. When replacing side bearing, measure bearing width using Master Gauge KV38102000 and Weight Block ST32501000 prior to installation. See Figure PD-46.

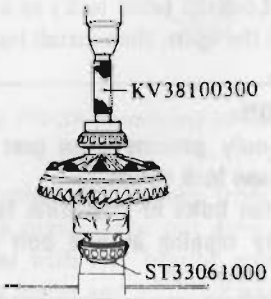
Standard bearing width:
21.00 mm (0.8268 in)



PD425

Fig. PD-46 Measuring bearing width

8. Press fit side bearing inner race on differential case with Gear Carrier Side Bearing Drift KV38100300 and Adapter ST33061000. See Figure PD-47.



PD353

Fig. PD-47 Installing side bearing inner race

ADJUSTMENT OF DRIVE PINION PRELOAD

Adjust drive pinion preload with spacer and washer between front and rear bearing inner races, regardless of thickness of pinion height adjusting washer.

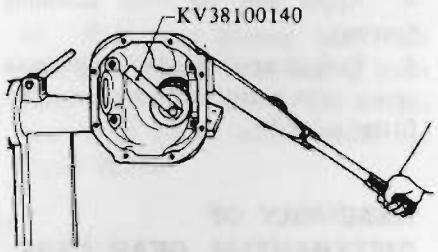
This adjustment must be carried out without oil seal inserted.

1. Press fit front and rear bearing outer races into gear carrier using Drive Pinion Outer Race Drift Set ST30611000, ST30613000 and ST30621000.

Front:	ST30611000 and ST30613000
Rear:	ST30611000 and ST30621000

2. Insert rear bearing inner race into Dummy Shaft KV38100110.
3. Fit drive pinion bearing spacer, washer, front bearing inner race, Dummy Shaft Collar KV38100130 and companion flange in that order on dummy shaft and tighten drive pinion nut to specified torque with Stopper KV38100140. See Figure PD-48.

Tightening torque of pinion nut:
19 to 22 kg-m
(137 to 159 ft-lb)



PD354

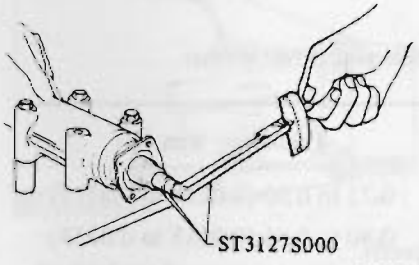
Fig. PD-48 Tightening drive pinion nut

4. Measure pinion bearing preload using Preload Gauge ST3127S000, and select washer and spacer that will provide required preload. See Figure PD-49.

Pinion bearing preload
(without oil seal):
10 to 13 kg-cm
(8.7 to 11.3 in-lb)

Note:

a. **Replace bearing washer and spacer with thicker ones if pinion cannot be turned by hand while it is being tightened.**
b. **Preload of old bearing is the same value as that of a new bearing.**



PD340

Fig. PD-49 Measuring pinion preload

Pinion bearing adjusting spacer

Length mm (in)
55.10 (2.1693)
55.40 (2.1811)
55.70 (2.1929)
56.00 (2.2047)
56.25 (2.2146)

Pinion bearing adjusting washer

Thickness mm (in)
3.80 to 3.82 (0.1496 to 0.1504)
3.82 to 3.84 (0.1504 to 0.1512)
3.84 to 3.86 (0.1512 to 0.1520)
3.86 to 3.88 (0.1520 to 0.1528)
3.88 to 3.90 (0.1528 to 0.1535)
3.90 to 3.92 (0.1535 to 0.1543)
3.92 to 3.94 (0.1543 to 0.1551)
3.94 to 3.96 (0.1551 to 0.1559)
3.96 to 3.98 (0.1559 to 0.1567)
3.98 to 4.00 (0.1567 to 0.1575)
4.00 to 4.02 (0.1575 to 0.1583)
4.02 to 4.04 (0.1583 to 0.1591)
4.04 to 4.06 (0.1591 to 0.1598)
4.06 to 4.08 (0.1598 to 0.1606)
4.08 to 4.10 (0.1606 to 0.1614)

ADJUSTMENT OF DRIVE PINION HEIGHT

Adjust pinion height with washer located between rear bearing inner race and back of pinion gear.

1. Install Height Gauge KV38100120 on carrier with dummy shaft mounted. See Figure PD-50.

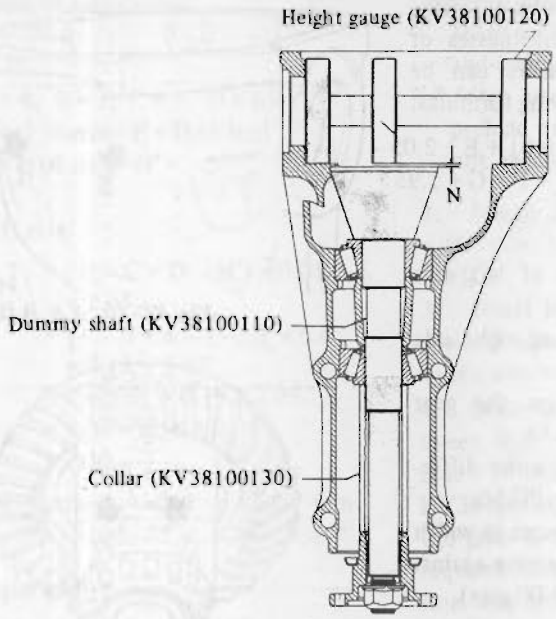


Fig. PD-50 Measuring the clearance (N)

2. Measure the clearance (N) between the tip end of height gauge and the end surface of dummy shaft, using a thickness gauge. See Figure PD-51.

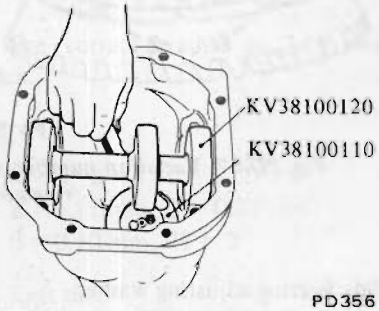


Fig. PD-51 Adjsuting pinion height

3. The thickness of drive pinion height adjusting washer can be obtained from the following formula:

$$T = N - [(H - D') \times 0.01] + 3.00$$

Where,

T : Required thickness of rear bearing adjusting washers (mm).
N : Measured value with thickness gauge (mm).
H : Figure marked on the drive pinion head. See Figure PD-25.
D' : Figure marked on the dummy shaft.

Note: Figures for H and D' are dimensional variations in a unit of 1/100 mm (4/10,000 in) against each standard measurement.

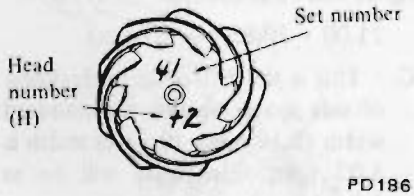


Fig. PD-52 Variation number on drive pinion

Examples of calculation

Ex. 1 ---

N = 0.23 mm
H = +2, D' = 1

$T = N - [(H - D') \times 0.01] + 3.00$
$= 0.23 - [((+2) - 1) \times 0.01] + 3.00$
$= 0.23 - [(2 - 1) \times 0.01] + 3.00$
$= 0.23 - [1 \times 0.01] + 3.00$
$= 0.23 - 0.01 + 3.00$
$= 3.22$ mm

The correct washer is 3.21 mm thick.

Ex. 2 ---

N = 0.35 mm
H = −1, D' = 2

$T = N - [(H - D') \times 0.01] + 3.00$
$= 0.35 - [((-1) - 2) \times 0.01] + 3.00$
$= 0.35 - [(-1 - 2) \times 0.01] + 3.00$
$= 0.35 - [(-3) \times 0.01] + 3.00$
$= 0.35 - [-0.03] + 3.00$
$= 0.35 + 0.03 + 3.00$
$= 3.38$

The correct washer is 3.39 mm thick.

Ex. 3 ---

N = 0.27 mm
H = 0, D' = 0

$T = N - [(H - D') \times 0.01] + 3.00$
$= 0.27 - [(0 - 0) \times 0.01] + 3.00$
$= 0.27 - [0 \times 0.01] + 3.00$
$= 0.27 - 0 + 3.00$
$= 3.27$

The correct washer is 3.27 mm thick.

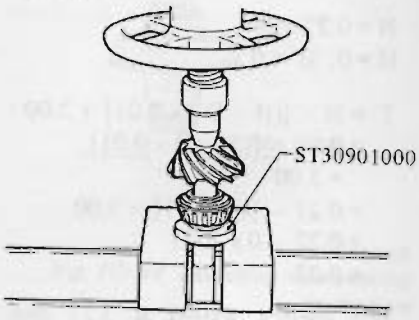
Note: If values signifying H and D' are not given, regard them as zero and compute. After assembly, check to see that tooth contact is correct. If not, readjust.
For the tooth contact pattern, see page PD-11 for Contact Pattern.

Pinion bearing adjusting washer

Thickness mm (in)
3.09 (0.1217)
3.12 (0.1228)
3.15 (0.1240)
3.18 (0.1252)
3.21 (0.1264)
3.24 (0.1276)
3.27 (0.1287)
3.30 (0.1299)
3.33 (0.1311)
3.36 (0.1323)
3.39 (0.1335)
3.42 (0.1346)
3.45 (0.1358)
3.48 (0.1370)
3.51 (0.1382)
3.54 (0.1394)
3.57 (0.1406)
3.60 (0.1417)
3.63 (0.1429)
3.66 (0.1441)
0.05 (0.0020)
0.07 (0.0028)

Note: Pinion height adjustment can be made in a unit of 1/100 mm (4/10,000 in) by selecting either 0.05 mm (0.0020 in) or 0.07 mm (0.0028 in) shim in above chart.

4. Fit determined pinion height adjusting washer in drive pinion, and press fit rear bearing inner race in it using Base ST30901000. See Figure PD-53.



PD092

Fig. PD-53 Pressing rear bearing inner race

Note: Insert washer into pinion with the chamfered side towards gear.

5. Lubricate pinion front and rear bearings. Install drive pinion in gear carrier into which drive pinion bearing spacer and washer, front bearing inner race and front pilot bearing spacer, moreover, pilot bearing and front oil seal are fitted. Fit front oil seal using Gear Carrier Front Oil Seal Drift KV38100500.

6. Fit companion flange on drive pinion, and secure it in position by tightening nut to specified torque confirming preload.

Tightening torque:
19 to 22 kg-m
(137 to 159 ft-lb)
Preload (with oil seal):
11 to 17 kg-cm
(9.5 to 14.8 in-lb)

Note: If drive pinion lock nut is worn, replace it.

ADJUSTMENT OF SIDE BEARING WASHERS

1. If the hypoid gear set, carrier, differential case or side bearing has been replaced with new part, adjust the side bearing preload with adjusting washer. The required thicknesses of the left and right washers can be obtained from the following formulas:

$T_1 = (A - C + D - H') \times 0.01 + E + 2.05$
$T_2 = (B - D + H') \times 0.01 + F + G + 1.95$

Where,

T_1 : Required thickness of left side washer (mm).
T_2 : Required thickness of right side washer (mm).
A & B : Figure marked on the gear carrier. See Figure PD-55.
C & D : Figure marked on the differential case. See Figure PD-56.
E & F : These are differences in width of left or right side bearing against the standard width (21.00 mm).

If bearing width is 20.82 mm, this figure will be as follows:

21.00 – 20.82 = 0.18 (mm)

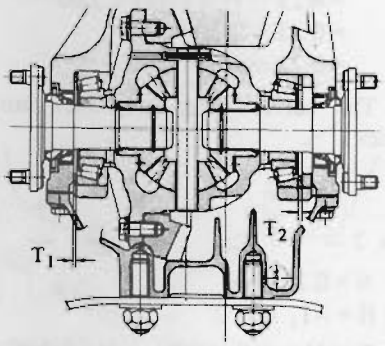
G : This is the difference in thickness of side spacer against the standard width (8.10 mm). If spacer width is 8.02 mm, this figure will be as follows.

H': Figure marked on ring gear. See Figure PD-57.
8.10 – 8.02 = 0.08 (mm)

Figures for A, B, C and D are dimensional variations in a unit of 1/100 mm against each standard measurement.

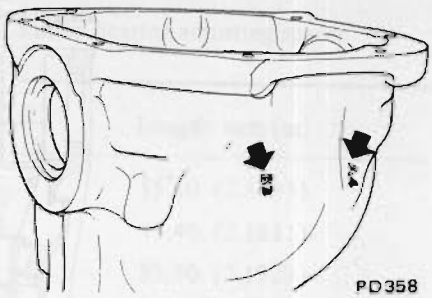
To measure width of side bearing, see differential case assembly procedure.

Before calculation, determine "G" value by measuring spacer thickness. If spacer is deformed or scratched, replace.



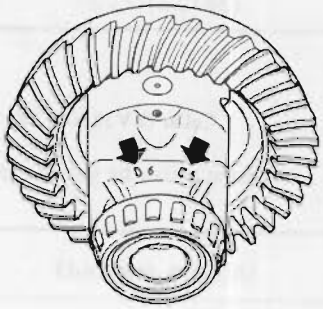
PD357

Fig. PD-54 Thickness of left and right washers



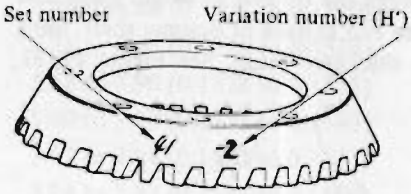
PD358

Fig. PD-55 A & B figures



PD359

Fig. PD-56 C & D figures



PD190

Fig. PD-57 Variation number on ring gear

Side bearing adjusting washer

Thickness mm (in)
2.00 (0.0787)
2.05 (0.0807)
2.10 (0.0827)
2.15 (0.0846)
2.20 (0.0866)
2.25 (0.0886)
2.30 (0.0906)
2.35 (0.0925)
2.40 (0.0945)
2.45 (0.0965)
2.50 (0.0984)
2.55 (0.1004)
2.60 (0.1024)

Example of calculation

Ex. 1 ---

A = 4, B = 3, C = 5, D = 6
E = 0.18 mm, F = 0.15 mm
G = 0.08 mm, H' = –2

Left side:

$T_1 = (A - C + D - H') \times 0.01 + E + 2.05$
$= [4 - 5 + 6 - (-2)] \times 0.01 + 0.18 + 2.05$
$= 7 \times 0.01 + 0.18 + 2.05$
$= 0.07 + 0.18 + 2.05$
$= 2.30$

The correct washer is 2.30 mm thick.

Right side:

$T_2 = (B - D + H') \times 0.01 + F + G + 1.95$
$= [3 - 6 + (-2)] \times 0.01 + 0.15 + 0.08 + 1.95$
$= (-5) \times 0.01 + 0.15 + 0.08 + 1.95$
$= -0.05 + 0.15 + 0.08 + 1.95$
$= 2.13$

The correct washer is 2.15 mm thick.

Ex. 2 ---

A = 6, B = 6, C = 5, D = 3
E = 0.17 mm, F = 0.22 mm
G = 0.10 mm, H' = 2

Left side:

$T_1 = (A - C + D - H') \times 0.01 + E + 2.05$
$= (6 - 5 + 3 - 2) \times 0.01 + 0.17 + 2.05$
$= 2 \times 0.01 + 0.17 + 2.05$
$= 0.02 + 0.17 + 2.05$
$= 2.24$

The correct washer is 2.25 mm thick.

Right side:

$T_2 = (B - D + H') \times 0.01 + F + G + 1.95$
$= (6 - 3 + 2) \times 0.01 + 0.22 + 0.10 + 1.95$
$= 5 \times 0.01 + 0.22 + 0.10 + 1.95$
$= 0.05 + 0.22 + 0.10 + 1.95$
$= 2.32$

The correct washer is 2.30 mm thick.

Note: If values signifying A, B, C and D are not given, regard them as zero and compute.
After assembly, check to see that preload and backlash are correct. If not, readjust.

2. Install differential case assembly with side bearing outer races into carrier.
3. Insert left and right side bearing preload adjusting washers in place between side bearings and housing.
4. Drive in side bearing spacer between R.H. washer and housing with Side Bearing Spacer Drift KV38100600. See Figure PD-58. If too great or too small a driving force is required, check to be sure that calculation and side bearing width are correct.

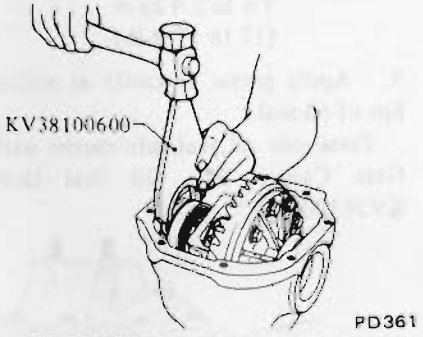


Fig. PD-58 Driving spacer into place

Note: When driving spacer into place, be careful not to tilt side bearing outer race to either side.

5. Align mark on bearing cap with that on carrier and install bearing cap on carrier. And tighten bolts to specified torque.

Tightening torque:
9 to 10 kg-m (65 to 72 ft-lb)

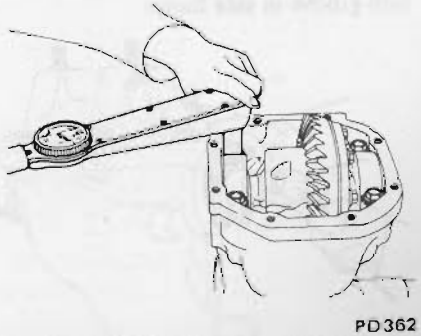


Fig. PD-59 Tightening side bearing cap

6. Measure ring gear-to-drive pinion backlash with a dial indicator and adjust it to 0.13 to 0.18 mm (0.0051 to 0.0071 in). See Figure PD-60.

If it is below the specified value, replace left washer with a thinner one and right washer with a thicker one. If it is over it, replace left washer with a thicker one and right washer with a thinner one.

Note: To maintain correct preload at all times, do not change total thickness of washers.

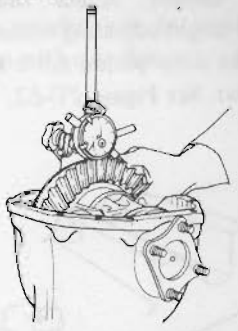


Fig. PD-60 Measuring the backlash of ring gear and pinion

Incidentally a decrease or increase in thickness of washers causes change in ring gear-to-pinion backlash.

Thus, check for proper backlash.

7. Check and adjust the tooth contact pattern of ring gear and drive pinion.

(1) Thoroughly clean ring and drive pinion gear teeth.
(2) Paint ring gear teeth lightly and evenly with a mixture of powdered red lead and oil of a suitable consistency to produce a contact pattern.
(3) Rotate pinion through several revolutions in the forward and reverse direction until a definite contact pattern is developed on ring gear.
(4) If contact pattern is incorrect, readjust thickness of adjusting washer.

Be sure to completely wipe off red lead upon completion of adjustment.

(5) Incorrect teeth contact pattern can be adjusted in the following manner.

Contact pattern

a. **Heel contact**

To correct, increase thickness of pinion height adjusting washer in order to bring drive pinion close to ring gear. See Figure PD-61.

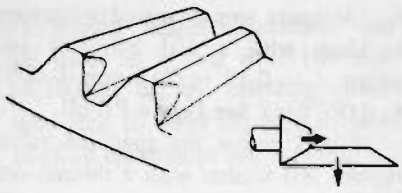

PD193

Fig. PD-61 Heel contact

b. Toe contact

To correct, reduce thickness of pinion height adjusting washer in order to make drive pinion move away from ring gear. See Figure PD-62.

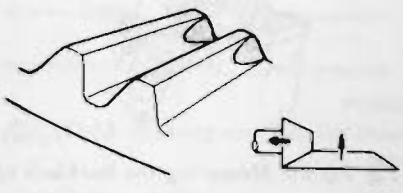

PD194

Fig. PD-62 Toe contact

c. Flank contact

Adjust in the same manner as in b. See Figure PD-63.

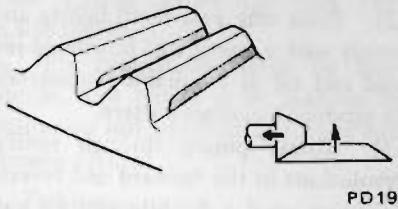

PD195

Fig. PD-63 Flank contact

d. Face contact

Adjust in the same manner as in a. See Figure PD-64.

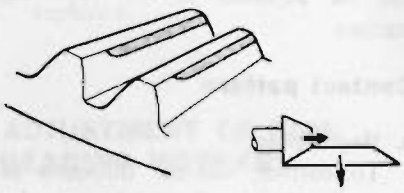

PD196

Fig. PD-64 Face contact

e. Correct tooth contact

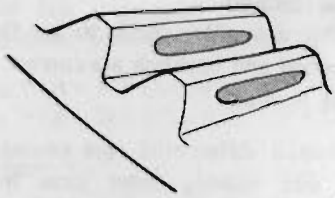

PD197

Fig. PD-65 Correct contact

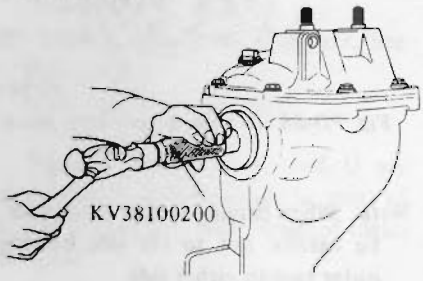
Note: Change in thickness of adjusting washer is accompanied by change in backlash. Check it when installing gear.

8. Install rear cover.

Tightening torque:
1.6 to 2.4 kg-m
(12 to 17 ft-lb)

9. Apply grease to cavity at sealing lips of oil seal.

Press side oil seal into carrier with Gear Carrier Side Oil Seal Drift KV38100200.



PD363

Fig. PD-66 Installing side oil seal

10. Install side flange on carrier. Engage spline in side flange with that in side gear and apply light hammer blows until side flange circlip is fitted into groove in side flange.

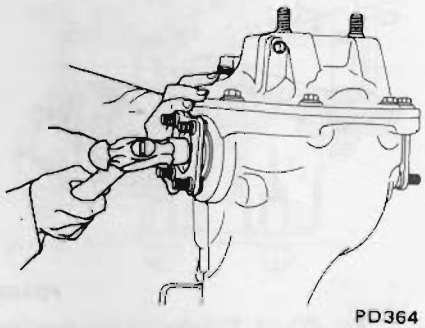

PD364

Fig. PD-67 Installing side flange

Note:

a. The length of side flanges differs for their locations. Install the shorter flange on the left side (ring gear) and the longer one on the right side.

b. Be careful not to scratch oil seal lips with side flange.

INSTALLATION

Install in the reverse order of removal. Refer to Section RA for Installation.

Note: Oil quantity: 1.3 liters
(2 ¾ U.S. pt., 2 ¼ Imp. pt., use API GL-5).

REPLACEMENT OF OIL SEALS

Replacement of oil seals with differential gear carrier assembly installed on the car.

FRONT OIL SEAL

Procedures are as follows:

1. Drain gear oil.
2. Raise car on hoist.
3. Remove insulator, exhaust tube and main muffler mounting bolt to free them from car body.
4. Detach propeller shaft.
5. Remove drive pinion nut.
6. Extract companion flange with a suitable puller.
7. Remove oil seal.
8. Set new oil seal in position with Gear Carrier Front Oil Seal Drift KV38100500. Apply grease to cavity between seal lips.
9. Fit companion flange on drive pinion, and secure it in position by tightening nut to specified torque confirming the following preload, with Drive Pinion Flange Wrench ST31530000.

Tightening torque of pinion nut:
19 to 22 kg-m
(137 to 159 ft-lb)
Pinion bearing preload (with oil seal):
11 to 17 kg-cm
(9.5 to 14.8 in-lb)
At companion flange bolt hole:
3.1 to 4.9 kg
(6.8 to 10.8 lb)

10. Reinstall rear stabilizer, propeller shaft and muffler in reverse order of removal, and fill up gear oil.

SIDE OIL SEAL

Side oil seal is replaced as follows:

1. Disconnect drive shaft on the gear carrier side.
2. Drive side flange out with pry bar.

Note: Hold side bearing flange with hand to prevent it from jumping out of carrier.

3. Remove oil seal.
4. Set in new oil seal with Gear Carrier Side Oil Seal Drift KV38100200.

Note: Apply grease to cavity between oil seal lips.

5. Install side flange on carrier. Engage spline in side flange with that in side gear and apply light hammer blows until side flange circlip is fitted into groove in side flange.
6. Join drive shaft with side flange and tighten nuts to specified torque.

Tightening torque:
5.0 to 6.0 kg-m
(36 to 43 ft-lb)

Note: Be careful not to scratch oil seal lips with side flange.

SERVICE DATA AND SPECIFICATIONS

		R180	R200
Gear ratio (number of teeth)		3.545 (39/11)	3.545 (39/11)
Drive pinion preload adjusted by		Washer	Washer
Drive pinion			
Preload (without oil seal)	kg-cm (in-lb)	10 to 13 (8.7 to 11.3)	10 to 13 (8.7 to 11.3)
(with oil seal)		11 to 17 (9.5 to 14.8)	11 to 17 (9.5 to 14.8)
Thickness of pinion height adjusting washer	mm (in)	3.09 (0.1217) 3.39 (0.1335) 3.12 (0.1228) 3.42 (0.1346) 3.15 (0.1240) 3.45 (0.1358) 3.18 (0.1252) 3.48 (0.1370) 3.21 (0.1264) 3.51 (0.1382) 3.24 (0.1276) 3.54 (0.1394) 3.27 (0.1287) 3.57 (0.1406) 3.30 (0.1299) 3.60 (0.1417) 3.33 (0.1311) 3.63 (0.1429) 3.36 (0.1323) 3.66 (0.1441)	3.09 (0.1217) 3.39 (0.1335) 3.12 (0.1228) 3.42 (0.1346) 3.15 (0.1240) 3.45 (0.1358) 3.18 (0.1252) 3.48 (0.1370) 3.21 (0.1264) 3.51 (0.1382) 3.24 (0.1276) 3.54 (0.1394) 3.27 (0.1287) 3.57 (0.1406) 3.30 (0.1299) 3.60 (0.1417) 3.33 (0.1311) 3.63 (0.1429) 3.36 (0.1323) 3.66 (0.1441) 0.05 (0.0020) 0.07 (0.0028)
Length of pinion bearing adjusting spacer	mm (in)	52.20 (2.0551) 52.40 (2.0630) 52.60 (2.0709) 52.80 (2.0787) 53.00 (2.0866) 53.20 (2.0945)	55.10 (2.1693) 55.40 (2.1811) 55.70 (2.1929) 56.00 (2.2047) 56.25 (2.2146)
Thickness of pinion bearing adjusting washer	mm (in)	2.30 to 2.32 (0.0910 to 0.0913) 2.32 to 2.34 (0.0913 to 0.0921) 2.34 to 2.36 (0.0921 to 0.0929) 2.36 to 2.38 (0.0929 to 0.0937) 2.38 to 2.40 (0.0937 to 0.0945) 2.40 to 2.42 (0.0945 to 0.0953) 2.42 to 2.44 (0.0953 to 0.0961) 2.44 to 2.46 (0.0961 to 0.0969) 2.46 to 2.48 (0.0969 to 0.0976) 2.48 to 2.50 (0.0976 to 0.0984) 2.50 to 2.52 (0.0984 to 0.0992) 2.52 to 2.54 (0.0992 to 0.0999) 2.54 to 2.56 (0.0999 to 0.1008) 2.56 to 2.58 (0.1008 to 0.1016) 2.58 to 2.60 (0.1016 to 0.1024)	3.80 to 3.82 (0.1496 to 0.1504) 3.82 to 3.84 (0.1504 to 0.1512) 3.84 to 3.86 (0.1512 to 0.1520) 3.86 to 3.88 (0.1520 to 0.1528) 3.88 to 3.90 (0.1528 to 0.1535) 3.90 to 3.92 (0.1535 to 0.1543) 3.92 to 3.94 (0.1543 to 0.1551) 3.94 to 3.96 (0.1551 to 0.1559) 3.96 to 3.98 (0.1559 to 0.1567) 3.98 to 4.00 (0.1567 to 0.1575) 4.00 to 4.02 (0.1575 to 0.1583) 4.02 to 4.04 (0.1583 to 0.1591) 4.04 to 4.06 (0.1591 to 0.1598) 4.06 to 4.08 (0.1598 to 0.1606) 4.08 to 4.10 (0.1606 to 0.1614)
Side gear and pinion mate			
Thickness of side gear thrust washer	mm (in)	0.75 to 0.80 (0.0295 to 0.0315) 0.80 to 0.85 (0.0315 to 0.0335) 0.85 to 0.90 (0.0335 to 0.0354)	0.75 to 0.80 (0.0295 to 0.0315) 0.80 to 0.85 (0.0315 to 0.0335) 0.85 to 0.90 (0.0335 to 0.0354)

	R180	R200
Pinion mate-to-side gear backlash (or clearance between side gear and thrust washer) mm (in)	0.1 to 0.2 (0.004 to 0.008)	0.1 to 0.2 (0.004 to 0.008)
Ring gear		
Ring gear-to-drive pinion backlash mm (in)	0.10 to 0.20 (0.0039 to 0.0079)	0.13 to 0.18 (0.0051 to 0.0071)
Thickness of side retainer shim (R180) or side bearing adjusting washer (R200) mm (in)	0.20 (0.0079) 0.25 (0.0098) 0.30 (0.0118) 0.40 (0.0157) 0.50 (0.0197)	2.00 (0.0787) 2.05 (0.0807) 2.10 (0.0827) 2.15 (0.0846) 2.20 (0.0866) 2.25 (0.0886) 2.30 (0.0906) 2.35 (0.0925) 2.40 (0.0945) 2.45 (0.0965) 2.50 (0.0984) 2.55 (0.1004) 2.60 (0.1024)
Side bearing standard width mm (in)	20.00 (0.7874)	21.00 (0.8268)
Oil capacity (about) liter (U.S. pt, Imp. pt)	1.0 (2⅛, 1¾)	1.3 (2¾, 2¼)
Tightening torque kg-m (ft-lb)		
Drive pinion nut	17 to 20 (123 to 145)	19 to 22 (137 to 159)
Ring gear bolt [using Locktite (stud lock) or equivalent]	9.0 to 10.0 (65 to 72)	6.0 to 7.0 (43 to 51)
Side bearing cap bolt	———	9.0 to 10.0 (65 to 72)
Side retainer bolt	0.9 to 1.2 (6.5 to 8.7)	———
Rear cover fixing bolt	4.0 to 5.0 (29 to 36)	1.6 to 2.4 (12 to 17)
Rear cover to rear mounting member lock nut	6.0 to 7.0 (43 to 51)	7.5 to 9.5 (54 to 69)
Differential carrier to front mounting Insulator fixing bolt	6.0 to 8.0 (43 to 58)	6.0 to 8.0 (43 to 58)
Companion flange to propeller shaft fixing bolt	3.5 to 4.5 (25 to 33)	3.5 to 4.5 (25 to 33)
Side flange to drive shaft fixing nut	———	5.0 to 6.0 (36 to 43)
Flange yoke to side gear fixing bolt	3.2 to 4.3 (23 to 31)	———
Filler and drain plug	4.2 to 6.9 (30 to 50)	4.2 to 6.9 (30 to 50)

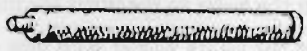
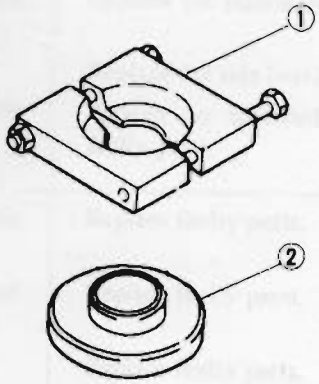
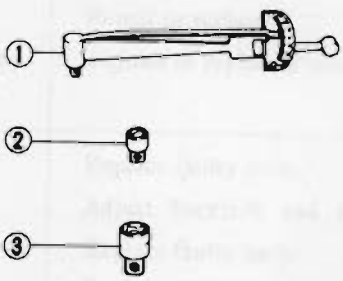
TROUBLE DIAGNOSES AND CORRECTIONS

When gear carrier is suspected causing noise, it is advisable to make a thorough test to determine whether the noise originates in the tires, road surface, exhaust, universal joint, propeller shaft, wheel bearings, engine, transmission, or gear carrier. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the rear axle assembly.

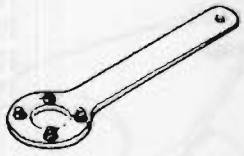
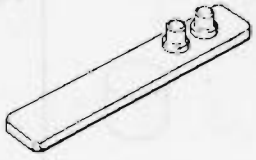
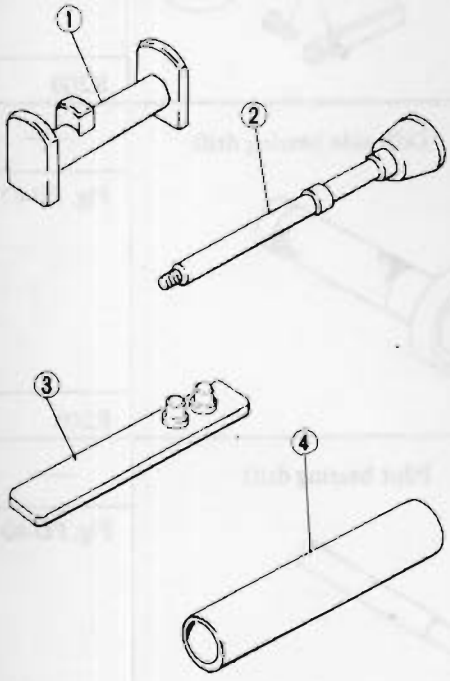
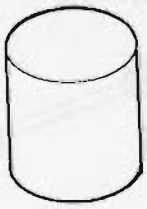
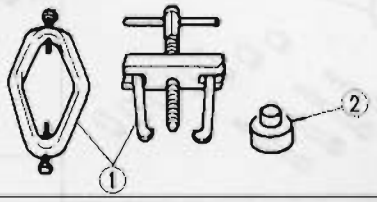
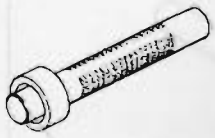
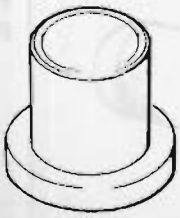
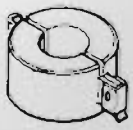
Condition	Probable cause	Corrective action
Noise during driving and/or coasting	Shortage of oil.	Supply gear oil. Rebuild gear carrier if necessary.
	Incorrect tooth contact between ring gear and drive pinion.	Adjust tooth contact or replace the hypoid gear set.
	Incorrect backlash between ring gear and drive pinion.	Adjust backlash or replace the hypoid gear set if necessary.
	Seized or damaged ring gear and drive pinion.	Replace the hypoid gear set.
	Seized, damaged or broken drive pinion bearing.	Replace the pinion bearing and faulty parts.
	Seized, damaged or broken side bearing.	Replace the side bearing and faulty parts.
	Loose bolts or nuts fixing ring gear, side bearing caps, etc.	Tighten to specified torque, and replace faulty parts.
Noise on turns.	Seized, damaged or broken side and pinion gears.	Replace faulty parts.
	Seized, damaged or broken side gear and pinion thrust washer.	Replace faulty parts.
	Pinion gears too tight on their shaft.	Replace faulty parts.
	Interference between side flange and differential case.	Repair the part responsible for interference, or replace the side flange and differential case.
Knocking sound during starting or gear shifting	Excessive backlash.	
	Incorrect backlash of ring gear-to-drive pinion or side gear-to-pinion gear.	Adjust backlash.
	Worn gears or case.	Replace worn parts.
	Worn side flange and side gear spline.	Replace worn parts.
	Pinion bearing under preload.	Adjust preload.
	Loose drive pinion nut.	Repair or replace.
	Loose bolts or nuts fixing ring gear, side bearing caps, etc.	Tighten or replace if necessary.
Seizure or breakage.	Shortage of oil or use of unsuitable oil.	Replace faulty parts.
	Excessively small backlash.	Adjust backlash and replace as required.
	Incorrect adjustment of bearings or gears.	Replace faulty parts.
	Severe service due to excessive loading, improper use of clutch.	Replace faulty parts.
	Loose bolts and nuts, such as ring gear bolts.	Replace faulty parts.

Condition	Probable cause	Corrective action
Oil leakage.	Worn-out, damaged or improperly driven front oil seal, or bruised, dented or abnormally worn slide face of companion flange.	Replace the faulty oil seal. Ammend the affected flange with sandpaper or replace if necessary.
	Worn, damaged or improperly driven side oil seal, or bruised, dented or abnormally worn slide flange.	Treat as above.
	Loose rear cover bolts.	Tighten the bolts to specified torque.
	Worn rear cover gasket.	Replace the faulty gasket with new one.
	Loose filler or drain plug.	Tighten the plug.
	Clogged or damaged breather.	Repair or replace.

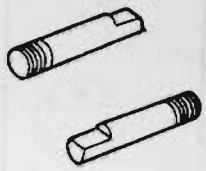
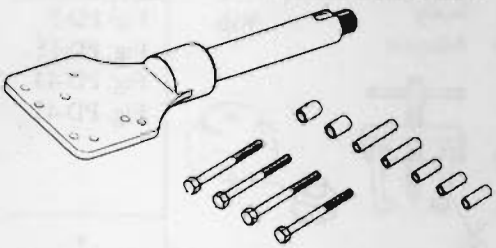
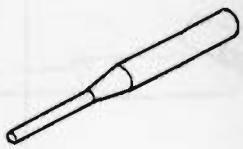
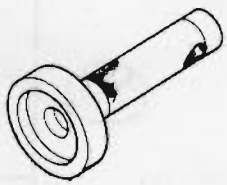
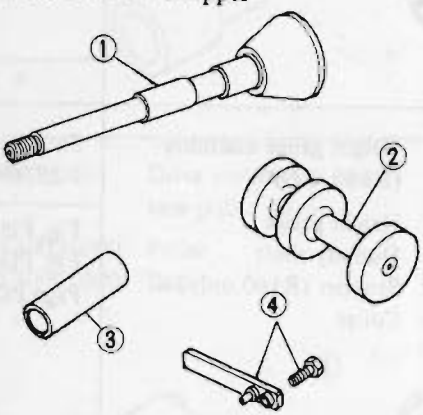
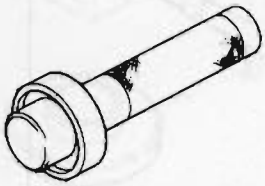
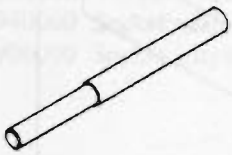
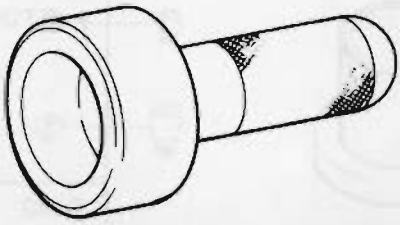
SPECIAL SERVICE TOOLS

Tool number & tool name	Kent-Moore No. / Reference page or Fig. No. / Unit application
ST30611000 Drive pinion outer race drift bar 	J 25742-1 Page PD-8 Page PD-18 *
ST30613000 Drive pinion outer race drift 	J 25742-3 Page PD-18 R200 (Front)
ST30621000 Drive pinion outer race drift 	—— Page PD-8 Page PD-18 *
ST30650001 Pilot bearing drift 	J 25749 Page PD-6 R180
ST30701000 Drive pinion outer race drift 	J 25742-2 Page PD-8 R180 (Front)
ST30720000 Gear carrier front oil seal drift 	J 25751 Page PD-10 Page PD-12 R180
ST3090S000 Drive pinion rear inner race puller set 1 ST30031000 Puller 2 ST30901000 Base 	—— Fig. PD-6 Fig. PD-17 Fig. PD-41 Fig. PD-53 Page PD-9 *
ST3127S000 Preload gauge ① GG91030000 Torque wrench ② HT62940000 Socket adapter ③ HT62900000 Socket adapter 	See J 25765 Fig. PD-13 Fig. PD-33 Fig. PD-49 *

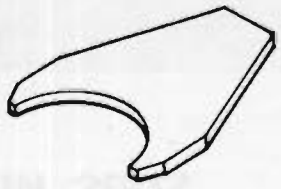
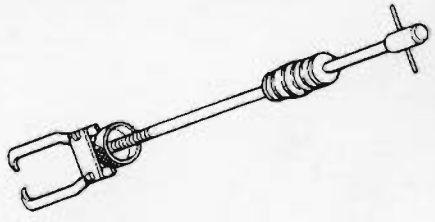
*: Applicable to all S30 series models

Tool number & tool name	Kent-Moore No. / Reference page or Fig. No. / Unit application
ST31530000 Drive pinion flange wrench 	J 25774 Page PD-12 Page PD-22 Fig. PD-5 Fig. PD-38 *
ST31852000 Stopper (R180) 	— Fig. PD-12 R180
ST3121S000 Height gauge assembly (R160, R180) ① ST31211000 Height gauge ② ST31212000 Dummy shaft ③ ST31213000 Stopper (R160 only) ④ ST31214000 Collar 	See J 25269-01 Fig. PD-14 Fig. PD-15 Page PD-8 R180
ST32501000 Weight block 	J 25407-3 Fig. PD-10 Fig. PD-46 *
ST3306S001 Diff. side bearing puller set ① ST33051001 Body ② ST33061000 Adapter 	— Fig. PD-7 Fig. PD-11 Fig. PD-43 Fig. PD-47 *
ST33230000 Diff. side bearing drift 	J 25805-01 Fig. PD-11 R180
ST31851000 Spacer (R180) 	See J 25269-01 Page PD-8 R180
ST33270000 Gear carrier side oil seal drift 	J 25809 Page PD-8 R180

*: Applicable to all S30 series models

Tool number & tool name	Kent-Moore No. / Reference page or Fig. No. / Unit application
ST33290001 Side bearing outer race puller 	J 25810 / Fig. PD-4 / R180
ST33720000 Gear carrier side retainer guide (R160, R180) 	J 25817 / Fig. PD-22 / R180
KV38100800 Gear carrier attachment 	— / Fig. PD-3 Fig. PD-32 / *
KV31100300 Solid punch 	— / Page PD-7 Page PD-16 / *
KV38100200 Gear carrier side oil seal drift 	— / Page PD-23 Fig. PD-66 / R200
KV381001S0 Drive pinion setting gauge set (R200) ① KV38100110 Dummy shaft ② KV38100120 Height gauge ③ KV38100130 Collar ④ KV38100140 Stopper 	— / Page PD-18 Fig. PD-48 Fig. PD-50 Fig. PD-51 / R200
KV38100300 Diff. side bearing drift 	— / Fig. PD-47 / R200
KV38100401 Pilot bearing drift 	— / Fig. PD-40 / R200
KV38100500 Gear carrier front oil seal drift 	— / Page PD-20 Page PD-22 / R200

*: Applicable to all S30 series models

Tool number & tool name	Kent-Moore No. Reference page or Fig. No. Unit application
KV38100600 Side bearing spacer drift 	— Fig. PD-58 R200
KV38101900 Master gauge [20.0 mm (0.787 in)] 	— Fig. PD-10 R180
KV38102000 Master gauge [21.0 mm (0.827 in)] 	— Fig. PD-46 R200
HT72400000 Slide hammer 	— Fig. PD-37 R200

*: Applicable to all S30 series models